KRAUS

AMPEX

MAINTENANCE MANUAL FOR VR 5000

Figure A

SPECIFICATIONS

POWER REQUIREMENTS
VR5000: 105 to 125 volts, 60 cycle at 2½ amps
Detachable 3-wire power cable and plug.
VR5003: 80 to 140 volts, 50 HZ at 2½ amps
190 to 250 volts, 50 HZ at 1¼ amps, detachable 3 wire power cable and plug.

VIDEO INPUT REAR PANEL SWITCH SELECTS:
Either UHF connector or remote connector. Both connectors are 75 ohms, unbalanced, terminated internally.

VIDEO OUTPUT
75 ohms unbalanced, .8 V P-P Min. (EE or Play).
UHF type connector.

MODULATOR OUTPUT
Video modulated radio frequency output.
UHF type connector.
Tuneable through channels 2 to 5 for use with standard TV receiver, Recorder preset to Channel 4.
Nominal output 30 millivolts into 75 ohm load.
Connects to TV receiver antenna terminals.

AUDIO INPUTS REAR PANEL SWITCH SELECTS:

Input	Sensitivity (100% Record level)	Impedance
Microphone	1.8 MV.	80K ohms
Line	96 MV.	47K ohms
Remote	96 MV.	47K ohms

Microphone and line inputs use an XL type connector.

AUDIO OUTPUTS
1. 10K ohm unbalanced line. 1.0 volt nominal output. XL type connector.
2. 8 ohms, 3 watt feeding internal speaker. Available externally at speaker jack.

VIDEO RESPONSE
30 HZ to 2.5 MHZ +2, −6db

VIDEO SIGNAL TO NOISE
40db, Peak-to-Peak signal to rms noise.

HORIZONTAL RESOLUTION
250 lines limiting visual resolution on monoscope test pattern.

AUDIO RESPONSE
±4db, 90 HZ to 9 KHZ

AUDIO SIGNAL TO NOISE
39db from peak record level.

AUDIO FLUTTER AND WOW
Flutter: less than .3% rms .5-250 HZ
Measured according to ASA Standards
Wow: less than .04% rms .5-6 HZ

TAPE SPEED
VR5000: 9.62 ips
VR5003: 9.45 ips

VIDEO WRITING SPEED
VR5000: 1000 ips
VR5003: 833 ips

ROTARY HEAD LIFE
500 hrs.
Will require adjustment after 250 hrs.
Uses a single plug-in field interchangeable head.

REWIND TIME
VR5000: 5 minutes (for 3000 ft. of tape).
VR5003: 5 minutes (for 3000 ft. of tape).

FAST FORWARD TIME
VR5000: 15 minutes (for 3000 ft. of tape).
VR5003: 17 minutes (for 3000 ft. of tape).

REMOTE CONTROL FACILITY
Remote control connections available for play, record and stop at back panel for use with remote control device or Ampex CC6455 camera.

TAPE
1" wide, 1 mil mylar base video tape.
3000 ft. for 1 hr. recording time on 9¾" reel.

CASE
Vinyl clad sheet aluminum with die cast end frames incorporating swing-out handles, removable dust cover is of similar construction.

SIZE
Overall 23¼" × 18¼" × 12½".

WEIGHT
VR5000: 62 lbs.
VR5003: 63 lbs.

OPERATING POSITION
Horizontal only.

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GENERAL INFORMATION

DESCRIPTION

The Ampex VR5000 circuit design has resulted in a portable video tape recorder (Figure A) that maintains a high level of quality at a low cost. Helical scan recording, which is similar to that used in other recorders of the Ampex VR6000 and VR7000 video series is employed in the VR5000 and VR5003.

This recorder is intended for industrial, educational, hospital and home use. Picture quality is comparable to, or better than that of a standard television receiver.

A minimum number of controls makes it extremely easy to operate; and coupled with its versatility, a video camera, video line or audio line source may be used. Full interchangeability with all Ampex recorders using this format is guaranteed. Stop motion is available to permit examination of single frames.

Head life is 500 hours with an adjustment required after 250 hours. Plug-in head characteristics make it possible to provide field replacements with a minimum of adjustments. Maintenance is further simplified by the wrap-around case design that allows removal by simply unscrewing the rubber bumpers that serve as the legs for the cabinet.

A maximum recording time of 60 minutes is provided by the 3000-foot reel of one-inch Ampex 147 Series videotape. An air film is developed between the rotating drum and recording tape which reduces friction in the tape loop.

For maximum flexibility, two video outputs are provided. One is a composite video output for use with a standard closed circuit monitor and the other is a modulated RF output that can be connected to the antenna terminals of a conventional television receiver. The modulated R.F. output is adjustable to Channels 2 through 5.

THEORY OF MAGNETIC TAPE RECORDING

In addition to the mechanical system, three essential elements are required for recording and reproducing; the recording medium, the recording circuits, and the reproducing circuits. The recording medium is tape. The tape consists of two parts, the base and the magnetic coating.

The base is usually cellulose acetate or polyester plastic. Physical properties — playing time, strength, smoothness, curl, twist, stickiness, print through, and deterioration time — are determined by the base.

The magnetic coating consists of iron oxide particles, which are needle shaped and lie in a lengthwise direction on the tape. A binder material holds the particles in place, and makes the particles adhere to the base. This material determines the tape's magnetic properties — frequency response, sensitivity, distortion and signal-to-noise ratio.

The surface of the oxide coating is highly polished to minimize wear of the heads, and improve the contact between the tape surface and head gap.

If the recording field is applied in the direction of tape motion it is called longitudinal recording. If the field is from edge-to-edge it is called transverse, while a field from face-to-face is called perpendicular. Because of the shallow angle used, the field of the VR5000 is basically longitudinally oriented as it is applied in a helical path.

Magnetization results because of the existence of magnetic islands or tiny sectional magnets (domains) in the material. In an unmagnetized state there is complete disorder of these areas with mutual cancellation between the domains; the remaining field is almost zero. When an external field is applied to the tape, the individual domains tend to magnetically align along the axis of the field. The number that align is dependent on the strength of the applied field.

The length of the sectional magnets depends on the tape speed and the frequency of the magnetizing field. For high frequency signals they are short and have the effect of lying closer to the surface of the oxide. Thus, for a constant tape speed, the length of the sectional magnets varies inversely with the frequency of the signal.

In the magnetic recorder the field patterns are generated by the record head. The record head consists of a number of turns of wire to form a magnetic loop on' a highly permeable core material with a small gap. When recording or reproducing, the oxide surface of the tape contacts the gap in the core, thus completing the magnetic circuit through the tape surface. During the recording process, the current through the coil varies, and the sectional magnets within the oxide surface are aligned according to the direction and density of the record signal. Signal amplitude increases the density and the direction of head current determines the polarity. As the frequency increases, the spacing between the maximum density points decreases. In short, the recorded pattern on the surface of the tape resembles a series of tiny magnets that vary in polarity and density.

The process is reversed when reproducing. As the tape passes the gap in the play head, the magnetic circuit is completed and a voltage that is proportional to the rate of magnetic change is induced in the winding of the head. When the wavelength of the sectional magnets on the oxide equals the width of the gap, the rate of change becomes zero and induces no voltage. This is called the cutoff frequency; those frequencies above this range are not reproduced dependably. There are four other factors that contribute to the high frequency limitation. These are: recording demagnetization, self-demagnetization, penetration losses, and head losses. As pointed out previously, the reproduce head output increases with frequency up to a point

and then decreases rapidly to zero. This gap effect is the most serious single restriction on the high frequency response of the recorder. Figure 1-1 provides a graphical representation of the gap effect. From the illustration it can be seen that a constant current recording of the full frequency range at a given speed will produce an increasing output voltage up to a point and then rapidly drop to zero. This sudden drop-off of output is characteristic of all tape recorders and limits the number of octaves that can be effectively reproduced to approximately 10.

To summarize: the bandwidth that can be reproduced on magnetic tape is limited to approximately 10 octaves by the nature of the reproducing system, and the maximum frequency that can be reproduced is determined by the reproduce gap width and tape speed.

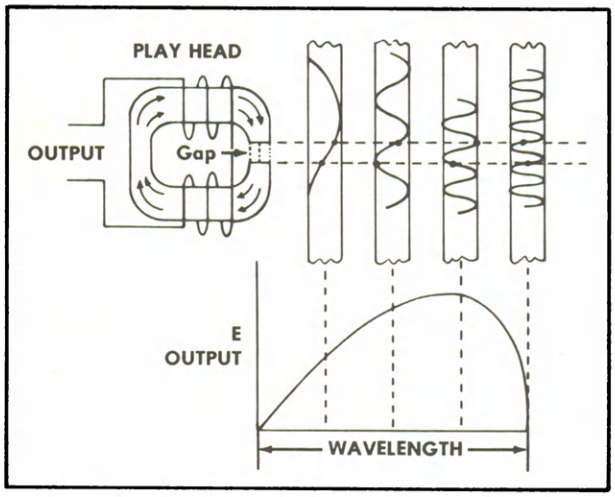


Figure 1-1. Graphical Representation of Gap Effect

RECORDING A COMPOSITE TELEVISION SIGNAL

Because a television signal extends from near dc to 3.5 megahertz, a bandwidth of almost 18 octaves, a method is required to transform the signal to a higher frequency spectrum and yet maintain the information contained in the original signal. This is achieved by converting the television signals to frequency modulated signals.

After the highest playback frequency is determined, and the minimum practical head gap established, the necessary tape speed can be calculated. The derived head to tape velocity for the required bandwidth is 1000 inches per second.

SINGLE HEAD HELICAL SCAN FORMAT

One video record-play head is utilized to record one field per scan or rotation of the drum. A drum speed of 3600 rpm is required because the drum rotation must follow each occuring field every 1/60 sec. The effective recorded tape length is based on the drum circumference, which can be calculated by dividing 60 (fields) into one. Multiplying this figure by the 1000 ips writing speed (required for proper frequency response) gives an effective length of 16.6 inches. The drum diameter then becomes 16.6 inches divided by Pi (3.14), or 5.3 inches.

Because the video and sync pulses are recorded on the tape in a series of parallel diagonal tracks (see Figure 1-2), the 9.6 inch longitudinal tape speed is required so that the horizontal sync pulses will line up from one track to the next. During slow motion, or speeds other than the original recorded speed, the video head crosses from track-to-track at some point. At this point signals from both tracks will be read at once. When the tape geometry is arranged so that the pulses are aligned, the information picked up from the two adjoining fields will be the same, including the sync timing. Any errors that may affect tape tracking will thus have less affect on picture stability.

As the tape enters, the head passes a point where it does not contact the tape. During this period, no information can be recorded or played back. This short absence of signal when the head does not contact the tape is called dropout. Position of the dropout with respect to the television signal is near the bottom of the picture, approximately two lines before the start of the vertical blanking.

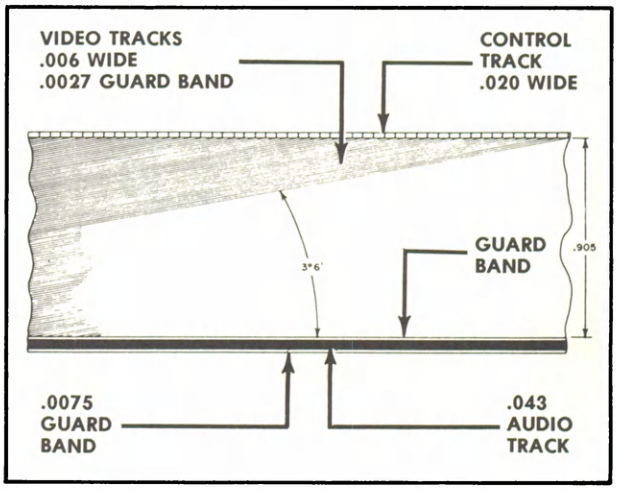


Figure 1-2. Videotape Recording Format

CARE OF VIDEO RECORDING TAPE

Ampex series 147 Video Tape is supplied with the recorder. This tape has a one mil Polyester base and is one inch in width.

Magnetic tape is a strong permanent recording medium, unaffected by ordinary handling or storage. However, it should be kept away from heat, moisture, and other magnetic materials. Avoid stretching the tape, or you will distort and destroy the quality of the recording. Avoid contact with the oxide surface of the tape as fingerprints or other contamination of oxide surface may cause the video head to clog (oxide buildup on surface of head) and result in loss of signal during recording or playback.

FUNCTIONAL OPERATION

(Figure 1-3)

When the switch is turned "ON" in the PLAY mode, power is applied to the circuit boards and the drive motors. The head drum motor also rotates because the motor control amplifier is energized. However, there is no tape motion unless the READY-THREAD knob is in the READY position and the PLAY button is depressed.

When the READY-THREAD knob is in the READY position and the PLAY button is depressed, the tape moves out from the supply reel over the tension arm, tape guides and capstan to the video/audio erase head. This head does not function in the PLAY mode. After the tape passes the erase head it is guided over the control track head. The output from the control track head is fed to the servo system for video head positioning information and correction of the motor speed. Output from the servo system is fed to the motor control amplifier, which in turn operates the drum motor, increasing and decreasing the speed as required.

The tape motion is then guided around the head drum in an angular loop. The bottom section of the drum is stationary while the upper half rotates at 3600 rpm. The video play head is attached to the upper drum and thus rotates with it. The tape wrap (angular loop) provides the proper recording and play angle as explained previously.

Signals from the video head are coupled to a preamplifier through a brush assembly. Output from the preamplifier in turn is coupled to a demodulator. The demodulated output couples to a jack on the rear panel, and then to a TV monitor or a modified TV set.

From the head drum the tape motion continues past the audio head where the variations of the magnetic field induce an audio signal into the play head. The audio signal is coupled to an audio amplifier and monitor amplifier. Output of the monitor amplifier feeds an internal speaker, or an external speaker when using the SPKR/PHONES jack. A line from the audio amplifier connects to the jack on the rear panel for connecting the output to an external amplifier. The tape motion continues over the capstan roller to the take-up reel, which revolves in a clockwise direction.

Transport operation and tape motion remains the same in the Record mode. However, circuit operation does change, and signal tracing is different. The bias oscillator, which was inoperative in the PLAY mode is now active. As the tape passes the erase head any previous recorded material is erased. A portion of the oscillator signal is fed to the audio amplifier for biasing. The control track head is energized, and it records a control signal on the tape. The video input signal is FM modulated before it is fed to the video record head. The audio signal is amplified by the audio amplifier and coupled to the audio record head. This completes record operation.

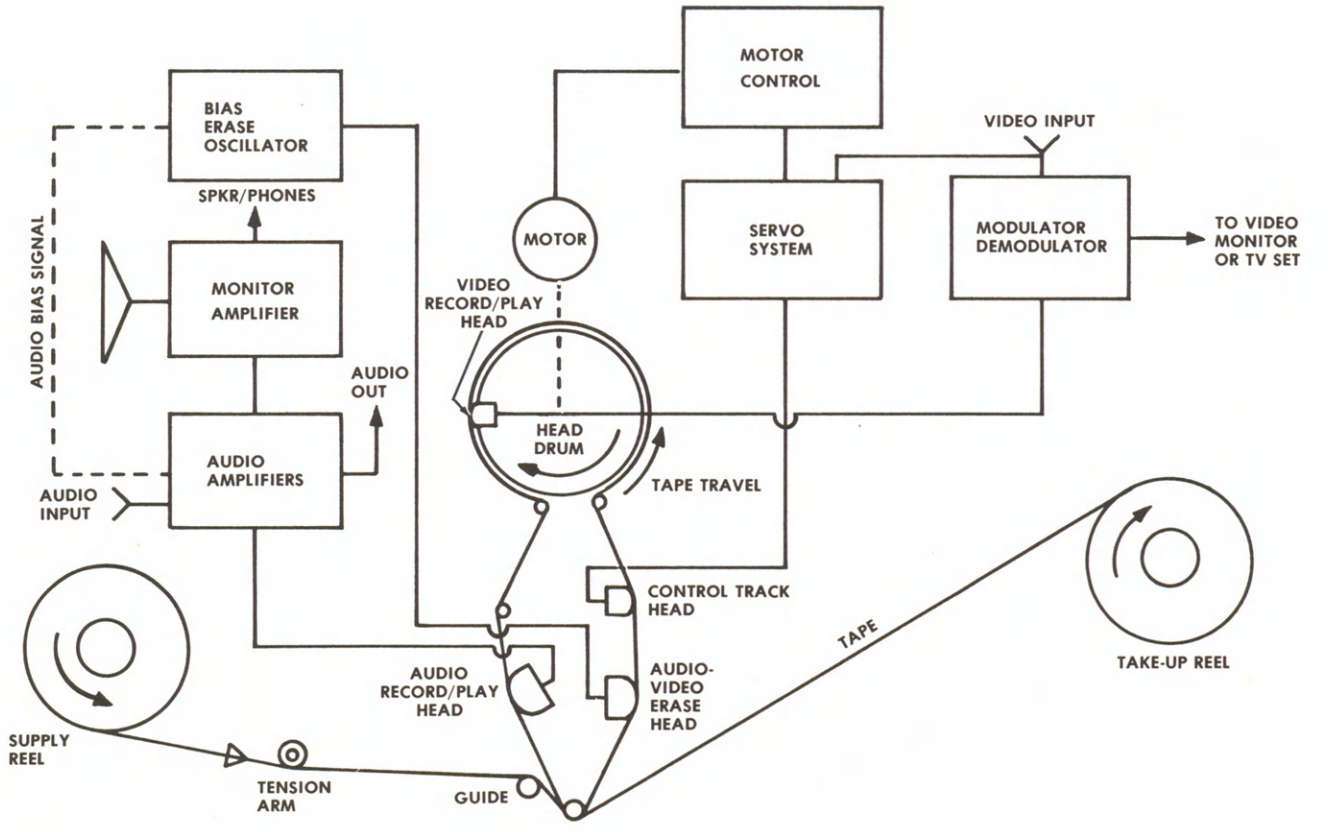


Figure 1-3. Functional Operation

INSTALLATION

GENERAL

To record live scenes, a video camera such as the Ampex Model CC6455, CC6400 or CC324 must be used as the pickup device. The CC6455 camera is connected to the remote socket on the rear panel of the videotape recorder with the cable and 12-pin connector (Ampex #145-007) supplied. An adapter (11 pin to 12 pin) is necessary to mate the CC6400 connector with the remote socket on the rear panel of the recorder. Use the BNC to UHF adapter (supplied) to connect a CC324 camera to the VIDEO IN connector on the rear panel. A monitor or TV receiver should be used for a visual display during record or playback.

An RF tuner or modified television receiver must be available for recording television pictures. Output of the RF tuner or modified TV receiver is connected to the recorder through coaxial cable. A 75 ohm RF line can also be used to supply video information to the recorder from any video system that uses industrial or EIA-type sync. A typical installation is shown in Figure 2-1.

CAMERA MONITOR-RECORDER CONNECTIONS

To use the system with a video camera such as the AMPEX Model CC6455, CC6400 or CC324, refer to Figure 2-1 and proceed as follows:

1. If a Model CC6400 camera is used, simply connect the 11-pin connector to a 12-pin adapter and plug the adapter into jack, J803 on the rear panel of the recorder (CC6455 does not require adapter). Set the VIDEO SELECTOR to REMOTE position. If a Model CC324 camera is used, connect the video output of the camera to the VIDEO IN connector (J805) on the rear panel of the recorder by using the coaxial cable and the BNC to UHF adapter that is supplied. Set the VIDEO SELECTOR (S802) on the rear panel to VIDEO IN position.

2. Connect the INPUT of the Monitor to the recorder VIDEO OUT connector jack, J806. If a conventional TV receiver is used as a monitor, connect the MOD OUT (J807) to the TV receiver antenna terminals. Tune the TV receiver to an unused channel (channel not providing TV reception) between 2 and 5 and adjust the MOD FREQ to that channel.

3. To record sound, connect a high impedance microphone (50,000 ohms or higher) to the AUDIO IN connector, J801, located on the rear panel (microphone connects to camera when using CC6400 or CC6455). Audio level must be adjusted to proper recording level.

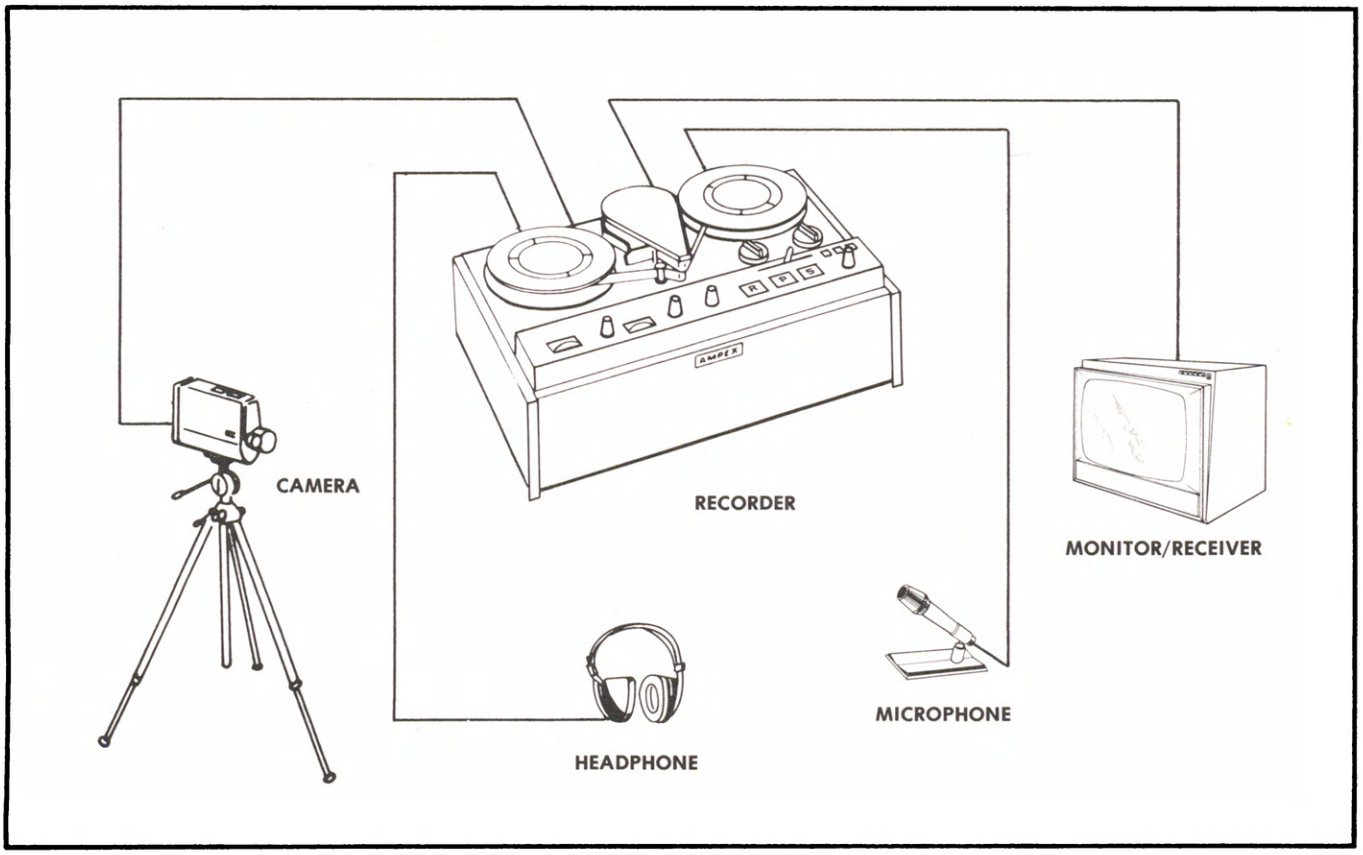


Figure 2-1. Typical Installation

RF MODULATOR FREQUENCY ADJUSTMENT

The RF MODULATOR frequency can be adjusted for channel 2, 3, 4 or 5. Set the TV receiver to the desired channel (2-5) and center the TV fine tuning. Adjust the CHAN ADJ with a slotted alignment tool for best picture. Refer to Figure 2-2.

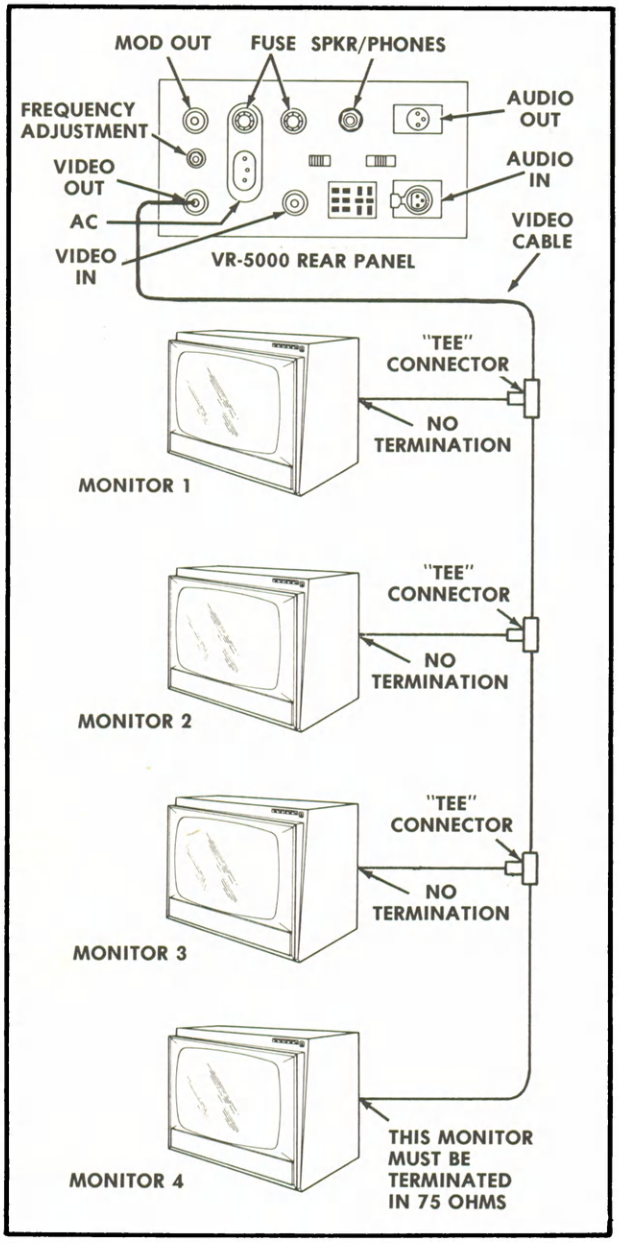


Figure 2-2. Multi-Monitor Connections

TELEVISION-MONITOR-RECORDER CONNECTIONS

To utilize the recorder in a system for recording television pictures and sound, proceed as follows:

1. Connect the video output of a television tuner or line supplying a television signal (video) to the VIDEO INPUT connector at the rear of the recorder. The video line will be terminated by the recorder into 75 ohms. Set the VIDEO IN/REMOTE switch to the VIDEO IN position (rear panel switch). Note: The recorder will not function properly if this switch is in the wrong position.

2. Connect the audio line to the AUDIO IN connector at the rear of the recorder and set the rear panel switch to the center (LINE) position.

3. The monitor can be connected to either the VIDEO OUTPUT or MODULATOR OUTPUT depending upon the monitor type (RF or Video).

MULTI-MONITOR CONNECTIONS

More than one monitor can be connected to the recorder, and these monitors can be installed in many different locations. Figure 2-2 illustrates a typical installation of 4 monitors. When making an installation of more than one monitor, terminate the last monitor on the line by using the built-in termination that is in the monitor, or by connecting a 75 ohm resistor across the line at the last monitor. Do not terminate any of the other monitors. Up to 500 feet of cable can be connected between the monitors and the output connector of the recorder without significant losses. Up to 10 monitors can be connected to the video output without degradation of picture quality.

If sound is essential at each monitor location, audio lines, using suitable pads for impedance matching, can be connected from the monitors to the AUDIO OUT connector. Small speaker amplifiers can be used to provide power amplification. As an alternate, the audio lines from the monitor locations can be connected to the SPKR/PHONES connector at the rear of the recorder. To vary the audio output level with this arrangement, adjusting the VOLUME control on the front panel will change the level at the external speakers.

The audio and video signals can be distributed through a single cable by using an audio/video modulator. A unit operating on channel 13 of the TV band is available as an off-the-shelf item. Two radio frequency carriers are produced for this channel and are modulated with both sound and picture signals, Channels 2 through 12 are available on special order. No special modified TV receiver is necessary when using the modulator as part of the distribution system. The output of the modulator feeds into the antenna network of the TV set.

HEADPHONE CONNECTIONS

Headphones having at least 4 ohms impedance may be plugged into the rear panel jack. These headphones must be equipped with a single circuit phone plug. When the headphones are plugged in the internal speaker is disconnected and will remain silent as long as the plug is in the speaker jack.

COMPLEX INSTALLATIONS

A complex system, as shown in the diagram Figure 2-3, includes more than one camera, a switching unit to select the desired camera, an audio mixer to mix or select the related audio input, several speakers and several TV monitors or receivers. If preferred, several TV receivers may be used instead of the cameras, or a combination of both. Signal connections are shown in the illustration with an encircled number to indicate the point of connection on the rear panel.

The speaker amplifier in the VR5000 can supply 3 watts rms to an 8 ohm load.

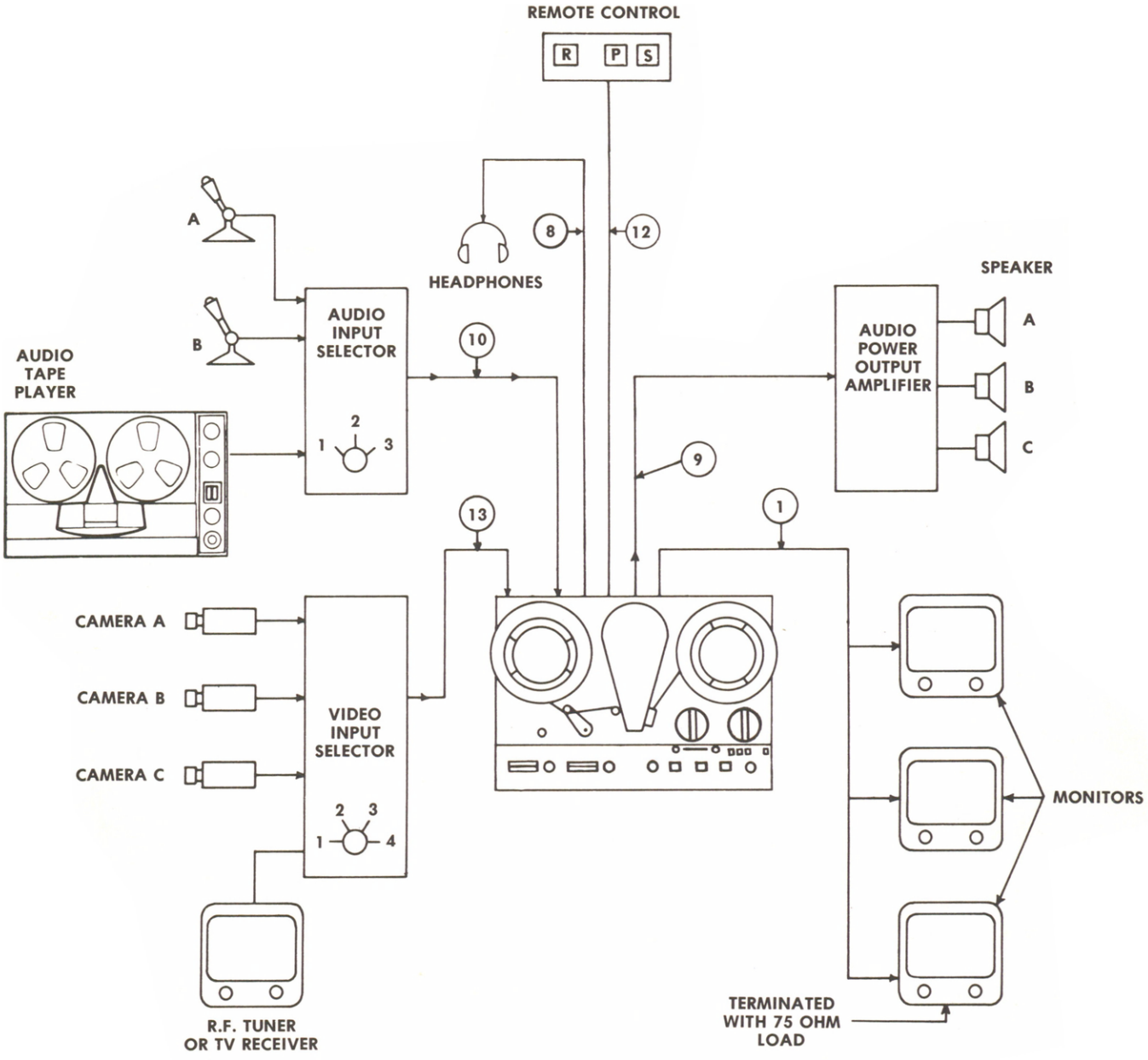


Figure 2-3. Complex Installation

AUDIO CONNECTIONS

Shielded audio cable should be used to connect microphones to the recorder line input (AUDIO IN). Shielded audio cable should also be used to connect the recorder line output (AUDIO OUT) to the line amplifier or distribution system. The recorder is wired for use with unbalanced connections only. See Figure 2-4 for wiring the connectors for an unbalanced circuit when using a single conductor shielded audio cable.

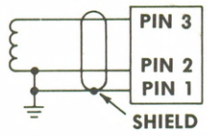
VIDEO CONNECTIONS

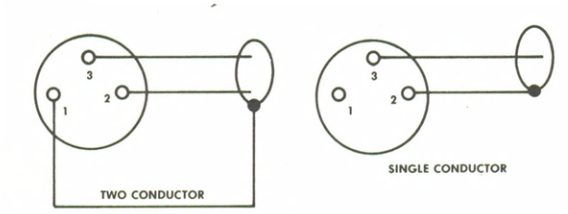
Video connections should be made to a good quality 75 ohm coaxial cable using UHF-type connectors to mate with the connectors at the rear panel of the recorder. This cable has its center conductor surrounded with a flexible shield and is covered with a plastic coating. If BNC-type cable connectors are used, use the BNC-to-UHF adapter that is supplied.

AUDIO CONNECTORS AS VIEWED FROM OUTSIDE CONNECTOR PANEL

PIN 1 IS ALWAYS GROUND (SHIELD CONNECTION).
PIN 2 IS ALWAYS GROUND WHEN USING UNBALANCED LINE
PIN 3 IS ALWAYS ABOVE GROUND.

UNBALANCED AUDIO





UNBALANCED UNBALANCED

Figure 2-4. Cable Connections

RF CONNECTIONS

Connection from the MODULATOR OUTPUT of the recorder to the TV antenna terminals can also be made with standard 75 ohm coaxial cable of the type used to make video connections.

REMOTE CONTROL CONNECTIONS

Remote control connections are made to the 12 pin connector at the rear panel. Connection is made as shown in Figure 2-5.

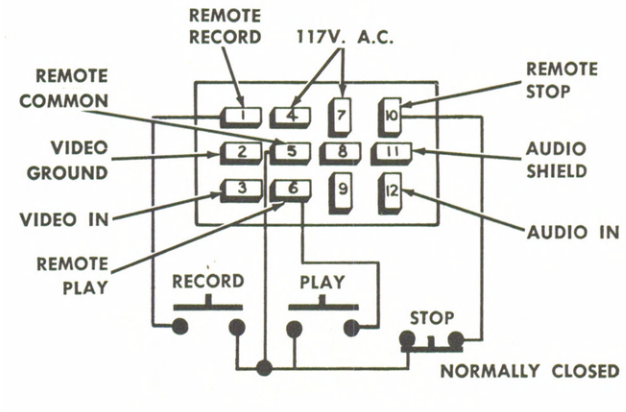


Figure 2-5. Remote Connector

DESCRIPTION OF CONNECTORS AND CONTROLS ON THE REAR PANEL

1. VIDEO OUT

Connects to a TV monitor or modified receiver. The output level, from a recording made at the 100% level, is .8 to 1.3 volts peak to peak into a 75 ohm load. This voltage is not adjustable.

2. AC IN

VR5000, 117 volts, 60 Hz. Three conductor, grounding type connector.

3. MOD FREQ

Controls the carrier frequency of the modulated video output for channels 2 through 5. To adjust, tune TV set to unused low frequency channel (2, 3, 4 or 5; channel not occupied by local TV station) and center the TV fine tuning control. Using a slotted tuning tool, or small screwdriver adjust for best picture on the receiver. The recorder is shipped with MOD FREQ control adjusted to channel 4.

4. MOD OUT

An r-f modulated output for connecting to the antenna terminals of a television receiver. It provides approximately 30 mv for TV channels 2 through 5.

5. FUSE

5 amp. A.C. line.

6. FUSE

½ amp., slow blow. Remote A.C. line.

7. VIDEO SELECTOR

Connects either the VIDEO IN or the REMOTE receptacle to recorder.

8. SPKR/PHONES OUTPUT

A phone type jack receptacle which connects to an external speaker, speaker amplifier system, or headphones.

9. AUDIO OUT

A three prong receptacle which connects to an external unbalanced 10K ohm line.

10. AUDIO IN

A three prong connector for line or microphone connection.

11. AUDIO SELECTOR

Selects line, microphone, or remote audio source.

12. REMOTE

12 pin receptacle with connections available for:

Record	Audio in
Play	Video in
Stop	117 V.A.C.

13. VIDEO IN

Connects to the output of the video source (camera, modified TV receiver or line).

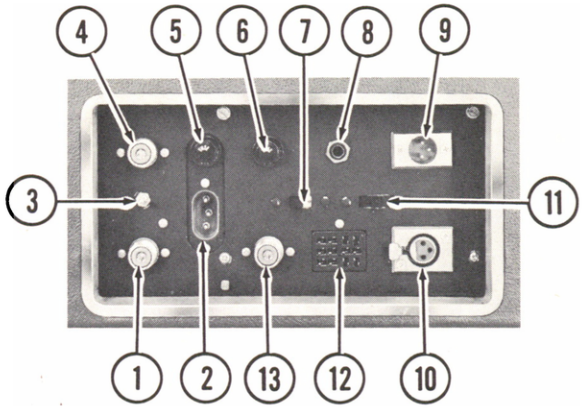


Figure 2-6. Location of Receptacles and Controls on Rear Panel

OPERATING INSTRUCTIONS

GENERAL INFORMATION

The operating controls of the Model VR5000 are all conveniently located on the front panel of the recorder. All controls are clearly identified as to their function and are grouped to allow adjustments with minimum operator movement. All front panel controls are identified in Figure 3-4 along with a complete description of each control function.

PREPARING TO RECORD

For good recordings, the heads, guides, capstan and drum should be cleaned after 4 hours of operation to remove dust and oxide deposits. The heads should also be demagnetized for optimum performance.

THREADING TAPE ON RECORDER

The tape used with the recorder is standard 1 inch width and is supplied on a 9¾ inch reel. Approximately 3000 feet of tape is on the reel. The supply reel (left hand reel) is wound with the oxide in; however as it is wound on the take-up reel (right hand reel) it is wound with the oxide out.

To thread the tape, refer to Figures 3-1 and 3-2 and proceed as follows:

1. Turn the READY-THREAD control clockwise to THREAD position. The knob turns hard at first because the first few degrees of rotation unlocks the mechanism. The tape guides also move out from beneath the head drum cover with this action.

2. Place a full reel of tape on the left-hand turntable. Make sure that the reel locks into the turntable lugs.

3. Unwind about 3 to 4 feet of tape from the reel.

4. Thread the tape around the tension arm (see Figure 3-2), and then around the inside of the guide assembly located to the left of the capstan.

5. Pull the tape around the outside of the capstan roller and around the inside of the movable guide arm assembly, then to the lower right-hand side of the head drum.

6. Wrap the tape around the head drum in a counterclockwise direction to the upper left-hand side of the drum (see Figure 3-2) and then past the inside of the movable tape guide to the upper half of the capstan roller. There should now be two levels of tape around the capstan.

7. Bring the tape to the right side of the capstan and to the right-hand reel. It is wrapped around the right-hand reel hub in a clockwise direction with the oxide surface facing outward.

8. Manually rotate the right-hand reel for adequate wrap on the reel.

9. Place READY-THREAD knob in READY position. Unit is now ready for operation.

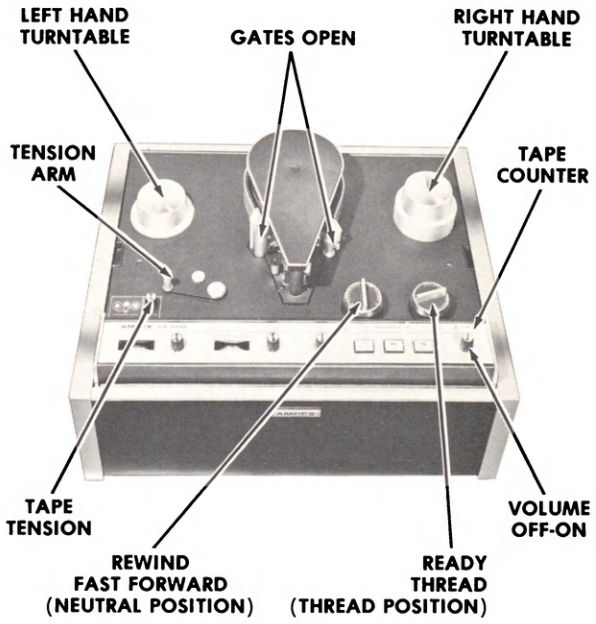


Figure 3-1. Threading Components

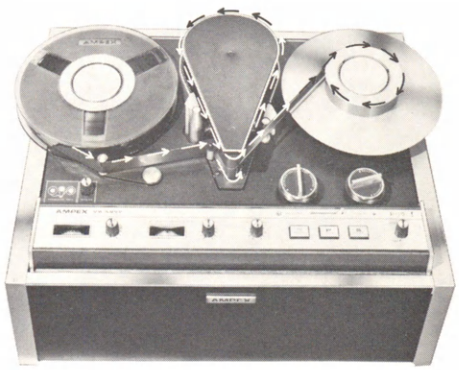


Figure 3-2. Tape Threading Path (Gates Open)

Figure 3-3. Tape Threaded (Gates Closed)

DESCRIPTION OF FRONT PANEL CONTROLS AND INDICATORS

1. AUDIO LEVEL METER

Indicates the level of audio signal to be recorded or played back.

2. AUDIO RECORD LEVEL CONTROL

Controls the AUDIO LEVEL to be recorded. Adjust for AUDIO meter indication of 100% at peak sound levels.

3. TENSION CONTROL

Adjusts tape holdback during play. Do not operate in the record mode. This control is released when the STOP button is depressed. Adjust for minimum pulling at the top of picture.

4. VIDEO LEVEL METER

Indicates video signal record level and tape signal on playback.

5. VIDEO RECORD LEVEL CONTROL

Controls the VIDEO (picture) LEVEL into the recorder. Adjust for VIDEO meter indication of 100% at peak video levels.

6. TRACKING

Controls the video head-to-tape tracking. Adjust for maximum indication on the VIDEO LEVEL METER. Operates in PLAY mode, in operative in the RECORD mode.

7. RECORD INTERLOCK BUTTON

Prevents accidental recording. Must be depressed to place the RECORD-PLAY lever in RECORD position.

8. RECORD BUTTON

Starts tape motion and erasure when depressed while the RECORD-PLAY lever is in the RECORD position. Inoperative during PLAY.

9. PLAY BUTTON

Starts tape motion when depressed while the RECORD-PLAY lever is in the PLAY position. Inoperative during RECORD.

10. STOP BUTTON

Places recorder in ready mode from PLAY or RECORD modes. Releases tape tension when depressed while in RECORD or PLAY modes. It is inoperative during FAST FORWARD or REWIND operations.

> **NOTE:** It is necessary to release the gates place Ready/Thread to Thread) or momentarily place the recorder in the Play mode, when stopping from a Rewind mode. The tape slackener feature does not provide tension release when stopping from this mode.

11. REWIND-FAST FORWARD CONTROL

Provides rapid, right-to-left tape motion in the REWIND position. In the FAST FORWARD position, it provides rapid left-to-right tape motion. Can be operated when recorder is in the RECORD, PLAY, or READY mode, but must be in the center position to play or record.

12. RECORD-PLAY LEVER

Selects PLAY or RECORD operation. The RECORD Interlock Button must be depressed to move the lever to the RECORD position. If the REWIND-FAST FORWARD control is moved to either function, the lever automatically returns to the PLAY position.

CAUTION

> Moving the lever to the record position, when in the ready mode, activates the video recording head and causes erasure of previously recorded video information. This feature makes it possible to momentarily record and playback to check the operation of the recorder and associated equipment without moving tape.

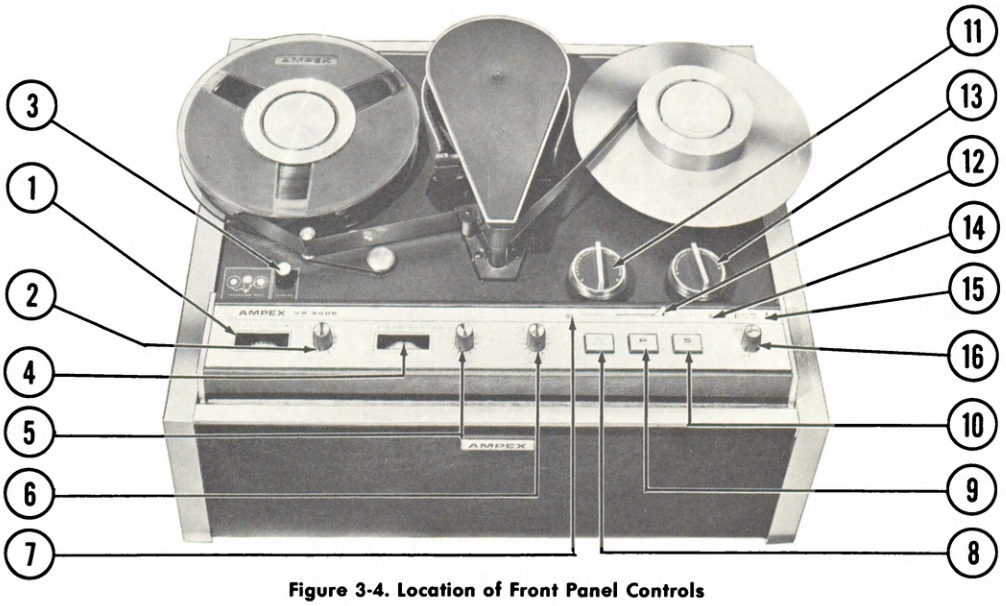


Figure 3-4. Location of Front Panel Controls

13. READY-THREAD

Moves the tape guides away from the drum to allow threading. Rotating to READY position pulls tape into its operating position. An interlock prevents the PLAY-RECORD and REWIND-FAST FORWARD controls from operating when the READY-THREAD control is not in READY position.

14. POWER ON INDICATOR

Indicates when the recorder power is on.

15. DIGITAL COUNTER

Indicates the tape position. Enables the operator to return to a predetermined place on the tape. The reset button returns the counter to 000 and may be depressed at any time.

16. ON-VOLUME CONTROL

Clockwise rotation to the ON position, applies power to the recorder. Further clockwise adjustment increases the sound level to the internal speaker as well as the SPKR/PHONES jack.

APPLICATION OF AC POWER

The recorder can now be connected to an AC source. To apply power to the recorder, turn the OFF/VOLUME knob clockwise until it clicks. The head drum should then rotate. If the drum has difficulty in reaching synchronous speed, the tape may be wrapped too tightly around the drum. If so, manually rotate the reels to provide a small amount of slack around the head drum.

PREPARING TO RECORD

To make a recording, it is necessary to connect the recorder to a video and audio source. A video monitor is required for viewing the recording while in progress. Instructions for connecting these components to the recorder are included in Section II. A complete video tape system is depicted in Figure 2-1.

The VR5000 is primarily intended for recording live scenes from a video camera or other line source. However, recordings can be made from a TV Receiver or a Tuner that has been modified for recording applications.

NOTE

Audio and video information is recorded simultaneously when in the record mode; but, the audio or video record circuits can be checked out separately by feeding the required signal to its respective connector and signal tracing the circuit board in question.

PROCEDURE:

1. Thread the tape and apply the AC power as previously described.

2. Depress the record interlock button (item 7, Figure 3-4) and hold while moving the RECORD/PLAY lever (item 12, Figure 3-4) to the left to RECORD. This is the RECORD-STANDBY mode.

3. Adjust the VIDEO RECORD LEVEL control (item 5, Figure 3-4) while camera or TV receiver is producing a scene on the monitor. VIDEO LEVEL meter should read 100% on a snow scene, darker scenes require a setting of approximately 85%.

4. To record audio in addition to video, set the AUDIO RECORD LEVEL control (item 2, Figure 3-4) for an AUDIO RECORD meter (item 1, Figure 3-4) indication of 100% on peak levels. Monitor audio and video levels while recording.

5. Depress the RECORD button to start the tape motion and begin recording. When the recording is complete, depress the STOP button.

NOTE

Turning the power switch OFF, or placing the unit in fast forward or reverse causes the RECORD lever to return to the PLAY MODE.

PLAYBACK PROCEDURES

To play video tape recordings it is necessary to connect the recorder to a monitor or television receiver. Connection to the monitor input is made from the recorder video output. When using a television receiver the recorder modulated output is connected to the receiver antenna terminals. The receiver channel selector is adjusted to any unused channel between 2 and 5. Adjust the modulator frequency for the best picture quality. The recorder is preset to channel 4.

PROCEDURE:

1. Thread the tape as instructed previously and apply AC power.

2. Check to see that the RECORD/PLAY lever (item 12, Figure 3-4) is in PLAY.

3. Depress the PLAY pushbutton (item 9, Figure 3-4) to start tape motion.

4. Adjust the TRACKING control (item 6, Figure 3-4) for a maximum indication on the VIDEO RECORD meter (item 4, Figure 3-4).

5. Adjust the TENSION control (item 3, Figure 3-4) for minimum bending at the top of the picture.

6. Set the VOLUME control (item 16, Figure 3-4) for the required audio level.

7. Depress the STOP button (item 10, Figure 3-4) when playback is complete.

REWINDING THE TAPE

1. The tape can be rewound at any time while the recorder power is ON simply by turning the REWIND-FAST-FORWARD knob counterclockwise until it locks into position. The tape should be rewound after a recording has been made so that it can be stored or played. (Gates must be closed for operation.)

NOTE

Do not leave the tape in the machine (while threaded) for extended periods of time. The tape can be damaged and dust and dirt will collect on the tape.

2. To go into fast-forward turn the REWIND-FAST FORWARD knob clockwise until it locks. It is not necessary to depress the STOP button when going into rewind or fast forward from either play or record operation.

3. To stop the tape movement when in REWIND or FAST-FORWARD, turn the REWIND-FAST-FORWARD knob to the center or neutral position.

NOTE

The stop button is ineffective for stopping tape motion during the rewind or fast forward modes.

HEADPHONE MONITORING

Headphones having an impedance of 4 ohms or higher can be connected to the rear panel HEADPHONE connector. This allows proper microphone level to be set without acoustic feedback. The internal speaker is silenced when external speakers or headphones are connected.

STILLFRAMING

A stillframe is a single field of a TV picture displayed on the monitor as a still picture. It is very similar to stop motion as used with a film type motion picture projector. To stillframe, proceed as follows:

1. Operate the recorder until the portion to be stillviewed appears on the monitor.

2. Depress the recorder STOP pushbutton.

3. If the picture has diagonal lines, or is torn, manually rotate the reels until the monitor shows a stillframe.

NOTE

The tape tension release will cause tape slack around the rotating drum. To remove this slack rotate the supply reel counterclockwise.

SPLICING PRERECORDED HELICAL SCAN VIDEOTAPE

A review of the record format is beneficial when splicing helical scan video tape. The video information, recorded on the tape, is a series of parallel diagonal tracks that extend almost all the way across the tape. In the case of (Ampex 1" format) the VR-5000 these tracks are 16.6 inches long, at approximately a 3° angle to the edges of the tape, and contain the information for a complete TV field.

In addition, a control track is recorded longitudinally along the upper edge of the tape. The control track consists of a series of uniformly-spaced pulses. These pulses are used by the recorder during playback to control the rotation of the scanning assembly so that the video head is in the proper position to follow the recorded video tracks.

The type of splice used in editing video tape depends upon the type of transition between scenes. If it is necessary to obtain an instantaneous transition from one scene to another, the splice must be parallel to the diagonal video tracks, and the control track pulse position error between the two pieces must not exceed .010 inches across the splice. "Edivue," can be used to make the magnetic tracks on the tape visible before making the splice.

A smooth transition between scenes can be obtained from a simple transverse splice if the control track pulse rate is not disturbed by the splice. In this case, the information of the new scene will first appear at the top of the monitor and then sweep downward, replacing the old scene. The transition time is 1¾ seconds. In making such a splice, it is also necessary to use "Edivue," to identify the position of the control track pulses on the tape.

If a transverse splice is made without attention to the position of a control track pulses, the monitor may roll during the transition; however, the picture disturbance will be under two seconds in duration. Because this type of splice is the simplest, it is recommended for splicing recorded tape if a picture roll can be tolerated and for all splicing of blank tape. The only requirements on such a splice are as follows:

1. The edges of the two pieces of tape must be precisely aligned so that there is no lateral displacement of the two pieces of tape at the splice and so that the two pieces of tape are parallel to each other. Failure to comply with this requirement will, at a minimum, increase the duration of the picture disturbance and may cause the recorder to stall.

2. The ends of the two pieces of tape must be butted together with a maximum of .010 inches clearance and without any overlap.

3. A proper splicing tape must be used. The splicing tape is applied to the back, or non-oxide, side of the tape only. This is the side of the tape that does not contact the recording heads.

4. The splicing tape must be trimmed so that it does not extend beyond the sides of the tape. It is permissible to undercut the edges of the tape at the splice area to meet this requirement.

There are several tape splicers on the market that will meet requirements 1 and 2. These are available at Radio/TV distributors. Splicing tape should preferably be 1/2 inch wide, .0005 inch thick and aluminized.

CIRCUIT ANALYSIS

GENERAL INFORMATION

Electronic components described in this section include those associated with the signal system, the head-drum servo system, the power supplies, the video control track, erase oscillator, and the audio system.

SIGNAL SYSTEM

The signal system contains circuits that process the video signal during RECORD and PLAY operation. These circuits, located on both the Mod-Demod and video head driver boards, are described in the following paragraphs. Those circuits found on the Mod-Demod are: modulator, demodulator, record play meter and equalizer. Circuits on the video head driver board are: record amplifier and play preamplifiers.

MODULATOR AND DEMODULATOR CIRCUIT FUNCTION

The modulator and demodulator are separate video signal processing circuits. Incoming video signals are converted to FM so that they can be recorded on tape. This function is necessary because the recorder cannot process the extreme frequency range of the AM video signal without converting it to FM.

Conversion is achieved through the use of the frequency modulation circuitry. Modulation is determined by the signal level delivered to the circuit. In operation the modulator is adjusted for a certain frequency, which is changed by the various levels of the incoming video signals. For example: whenever the input signal level corresponds to the blanking level, the modulator is operating at 4 MHz. As the input moves to peak white level, the frequency rises to 5.5 MHz. On the other hand, as the input level goes down to the tips of the synchronizing pulses, the frequency decreases to 3.5 MHz.

In the record mode the modulator output is amplified and fed to the rotating head, which varies the magnetic field of the tape accordingly. A portion of the signal (E-E signal) is fed to the demodulator so that the demodulated signal can be coupled to the TV monitor for observing the output.

Video signals fed directly to the frequency modulator (without pre-emphasis) produce an objectionable amount of high frequency noise. The eye is very sensitive to these signals, which would be included in the recorded signal.

To prevent this noise from being seen, the higher frequencies of the video signal are pre-emphasized by a network during the RECORD mode. When the tape is played, a circuit with inverse characteristics in the demodulator returns the video signal back to normal, and at the same time reduces the high frequency noise that is introduced during recording.

In the PLAY mode, the magnetic orientation of the tape induces a video signal into the play head. The recorded signal recovered from the tape is about one millivolt. At this point the main advantage of the FM conversion becomes apparent. Amplitude changes cannot affect the output because the information is recorded as frequency. As a result, the tape can be saturated during RECORD without the non-linear amplitude distortion when the tape is played. The play signal is fed through the limiter circuits to make it independent of input amplitude changes. The limiters remove any unwanted amplitude modulation that may be introduced by the tape irregularities and variable spacing between the head and tape.

Output from the limiter feeds a frequency demodulator; the modulation process is reversed and the signal is recovered.

MODULATOR CIRCUIT DESCRIPTION

The video input to the modulator is matched to a 75 ohm line by a 100 ohm potentiometer that is used to control the video level to the modulator.

The output that is developed across the video level control (R601) is coupled to the pre-emphasis network consisting of a 1000 pf capacitor (C402) and a 390 ohm resistor (R402) in parallel. At the higher frequencies the capacitor acts as a short circuit and couples the signal directly to the base of the following amplifier (Q401). The lower frequencies are dropped across resistor R401, which results in greater amplification of the higher frequencies. High frequencies are thus pre-emphasized with the changeover occuring at about 400 Hz.

The input video circuit is isolated from the modulator by a pair of emitter followers. Diode CR401 is a dc clamp to maintain the proper sync level and is adjusted by R408. Resistors R406 and R407 provide a divider network for the meter circuit. By tying the high end of the peak white adjustment control R415 to the divider, the dc clamp level is not changed when R415 is adjusted.

Output from the second emitter follower, Q403, is coupled to the voltage controlled oscillator (VCO) transistors Q406 and Q407. Diode CR402 couples the signal to the meter circuit and isolates the meter circuit from the emitter output.

Modulation takes place when variations in the signal voltage cause the oscillator frequency to vary. The frequency modulated output is coupled to pins 13 and 15 of jack J601. In the play position the base of Q406 is grounded through contacts on switch S401. Resistor R423 is a balance control for the two 180° (out of phase) signals that are applied to the head driver circuit.

METER CIRCUIT FUNCTION

The meter provides two distinct functions: (1) indicates signal level when recording and (2), provides tracking indication during playback. In playback the modulated RF is coupled from the preamplifier to the meter driver stage. Any small signal variations are bypassed by C408 to maintain a constant collector current to the meter. In playback the maximum RF is obtained when the head is tracking properly and is indicated by a maximum indication on the meter.

For record indication the rectified signal from CR402 is filtered by C406 and applied to the base of Q404. The peak white frequency control determines the emitter bias level of the transistor, and is adjusted for a 100% indication.

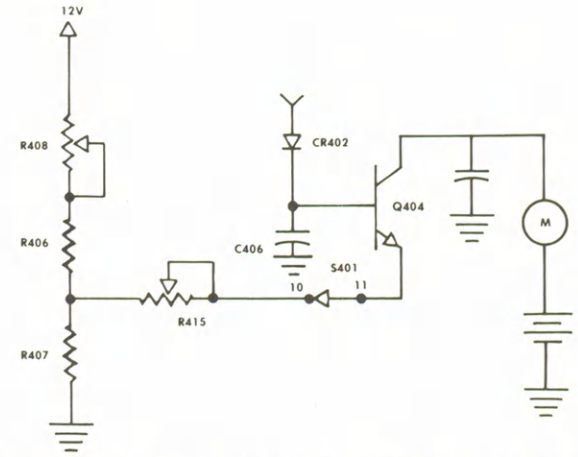


Figure 4-1. Simplified Schematic, Meter Circuit (Record Mode)

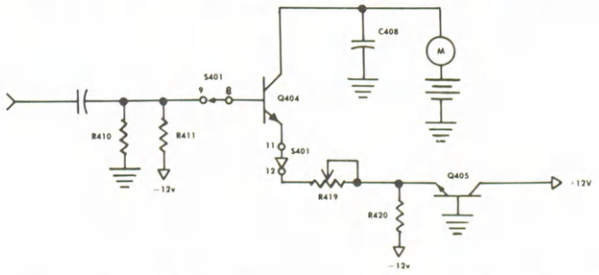


Figure 4-2. Simplified Schematic, Meter Circuit (Play Mode)

METER CIRCUIT DESCRIPTION

Only one transistor is used in the record mode. The record signal couples to the base of the meter amplifier, Q404, through contacts 7 and 8 of switch S401. The emitter of the transistor connects to a divider network that has one end grounded and the other end connected to the +12v source. Resistor R415 is used for adjusting the meter to indicate the proper level at peak white frequencies.

In the PLAY mode the signal from the preamplifier is coupled to the base of the meter amplifier, Q404, through contacts 8 and 9 of switch S401. In this mode the emitter does not go to ground but connects to the emitter of Q405 through resistor R419 and contacts 11 and 12 of switch S401. Emitter bias for this stage is developed by resistor R420, which connects to the −12v line. This stage operates as a DC amplifier.

DEMODULATOR CIRCUIT DESCRIPTION

In the record mode a part of the E-E signal from pin 21 is coupled to the base of Q410, a grounded emitter amplifier, through contacts of switch S401. However, in the play mode the signal from the RF preamplifier is coupled to the base of Q410 through pin 19 and another set of contacts on switch S401. Because the recording system uses vestigial sideband recording techniques, the upper sideband is partially attenuated by the video head and must be corrected in play.

Output from Q410 drives limiters CR405 and CR406 to provide positive and negative limiting. The remaining RF envelope assumes a square wave appearance. To provide better limiting action, another similar stage consisting of amplifier Q411, and limiters CR407 and CR408, follows. This added stage further removes any AM signal content from the FM signal, and reinserts those FM components (by harmonic addition) that were attenuated. Although the limiter does not produce perfect square waves, which contain an infinite number of frequency components, the first order sidebands are reinserted; this is sufficient for good operation.

Output from Q412 is fed to an emitter follower and then to a phase splitter Q414. The two out-of-phase signals are detected by diodes CR409 and CR410. Feeding the positive and negative pulses to the two diodes has the effect of doubling the carrier frequency. Assuming a demodulator input of an unmodulated 4 MHz carrier provides an output of 8 MHz. This doubling technique of the carrier allows the video tape recorder to use a carrier frequency just above the video band. The two signals are balanced by two controls, resistor R448 and capacitor C430, which are adjusted for minimum noise on the back porch of the blanking pulse.

SIGNAL DETECTION:

Two cascaded amplifier stages Q415 and Q416 follow the detector. An emitter follower couples the amplified output to a low pass filter network, which blocks the double carrier frequencies but passes video. If the demodulator output is an unmodulated carrier, the input to the filter is a series of pulses, and the output is a dc voltage that is equal to the average height of the pulse train. The shape of each pulse is determined by the R-C pulse forming network and the rate is double that of the incoming carrier. Decreasing the incoming carrier by one-half decreases the output pulses by one-half. Because their shape is unchanged, and the output voltage is equal to the average height of the pulse train, the dc voltage at the output of the filter is proportional to the carrier frequency. This is the method used by the demodulator to convert frequency variations into a dc voltage.

A grounded base amplifier, Q418, follows the filter. The output of the dropout circuit amplifier couples to the collector circuit of this stage and the combined output is coupled to an emitter follower. Resistor R465 and capacitor C441 provide the proper de-emphasis that is required by the record/playback characteristics of a magnetic recording. The output of emitter follower Q420 connects to pin 2 of the output and then to the output jack at the rear panel.

DROPOUT CIRCUIT FUNCTION

The dropout circuit suppresses any noise that may be present when no RF information is being received from the tape. If the output is not clamped, noise could trigger the sync circuits of the video monitor.

DROPOUT CIRCUIT DESCRIPTION

Output from the modified emitter follower, Q411, is applied to the base of amplifier Q423. The modulated RF envelope that is supplied to this stage has dropout occurring just before the vertical interval. Detection of this dropout is necessary; and it must be fed to a clamping stage so that the dropout signal can be clamped to the grey level (with respect to the composite video signal).

Dropout level is determined by the setting of potentiometer, R463, in the emitter circuit of Q423. Diode CR411 detects the carrier and C444 filters the RF from the dropout pulse. Transistor stage Q422 is direct-coupled to the clamping transistor Q421. When the amplified and inverted signal is direct coupled to the base of the clamping stage, Q421, the portion of the signal that corresponds to dropout is clamped above ground. Potentiometer R475 is adjusted to detect the loss of the RF signal from the preamplifier. Potentiometer R463 sets the dropout level and is adjusted to set the intensity of the dropout space.

SERVO CIRCUIT FUNCTION

The servo circuit is necessary to control the operation of the drum motor. A control track is recorded during the record mode to provide a reference of head position with respect to the video signal. Two inputs are supplied to the servo amplifier in the record mode. (1) tachometer pulses and (2), vertical sync pulses. The tac pulses are used as a reference for head position and vertical pulses are used as a reference for the location of the video signal. Each line of video that is played back must start in the proper position to provide a stable picture without streaks or tears.

Two inputs are also supplied to the servo amplifier during the play mode: tachometer pulses and the control track signal. A varying D.C. voltage is developed to correct the motor speed so that the head will be located in the proper position in relation to the pulses.

SERVO CIRCUIT DESCRIPTION

In the record mode the vertical sync signal is stripped from the video input signal by transistors Q201 and Q202 and is fed through an emitter follower Q203 to the base of Q211. Transistor Q211 acts as a pulse shaper through the charging action of capacitor C203, conducting only on the positive tips of the sync pulses. This circuit arrangement provides a degree of noise immunity and prevents small noise spikes from triggering the logic circuit. In the play mode, transistor Q211 is connected to the control track preamp and simply acts as a pulse forming amplifier with its output fed to the free running oscillator. This oscillator is adjusted to operate at 60 Hz when no output is present from Q211. When control track or sync is present it will lock to it even though it may be at a higher or lower free-run frequency.

In the play/standby mode, the drum speed is controlled by the free running oscillator rather than being locked to the line frequency. The free running oscillator output is fed to a delay one-shot. In the record mode, the delay is set by a potentiometer to locate the position of the dropout. In playback the delay is variable from one-half to 14 ms by using the tracking control. The delay voltage is monitored at the junction of resistor R240 and capacitor C214. Tac pulses are fed to a delay one-shot to produce a one-half ms delay in the record mode that is variable from one-half to 10 ms in the play mode using the tracking control. The delay in this mode is monitored at the junction of R218 and capacitor C215. Thus the delays result in a 23 ms movement of the drum in the play mode.

The tac pulses are generated by a tac coil and a rotating magnet that is mounted in a disc located under the drum motor. The monitored output of the tac coil pulse at TP201 has a 1.5 to 1.8v negative peak with the negative peak preceding the positive peak. Adjustment of the pulse is made by moving the pole pieces of the tac coil. Looking at the unit from the front, the head should be at the 1:30 o'clock position when the rotating magnet is under the pole pieces of the tac coil.

The tac input is controlled by the tac gate, which prevents the tac signal from triggering the logic if the drum is rotating too slowly. Absence of tac pulses causes the motor to speed-up and performs two functions: (1) it prevents the motor from hanging up at low speed and (2), it brings the drum to a lock-up condition rapidly from the initial start-up, or when the drum is slowed down by a bad section of tape. If the tac pulses are missing completely, the drum speed will be higher than normal. The output of the tac gate is set between .2v to .3v by using the tac gate control, R210.

The positive edges of the delayed sync pulses and tac waveforms control the logic flip-flop, which produces a rectangular wave. At test point TP204, the positive edge of the wave represents sync while the negative going edge represents tac. This signal is fed through a 9Hz low pass filter (24 db per octave) to extract the average value of the dc signal, which is fed through the lead network to the dc amplifier. An integrator circuit is connected to the opposite phase of the logic signal (because the integrator has a 180 phase shift) and is also fed to the dc amplifier. The infinite dc gain of the integrator circuit is developed by using positive feedback around the integrator. If a steady state error is introduced into the system after the integrator, the circuit will continue to compensate until the error is reduced to zero or until the limits of the integrator are exceeded. These limits are set by dividers R250, R251 and R252; the negative limit is set by CR209 while the positive limit is determined by saturation of Q218. These limits are quite important because they prevent high speed hang-up and ensure the fastest possible lock-in. The monitored output at TP204 is a square wave with a 53% positive period and a 47% negative period. Adjustment is made with the sync-tac period potentiometer R258.

The gain of the dc amplifier is controlled by the feedback circuit consisting of resistors R272, R273 and R276. A switching circuit shorts R272 during the record mode to change the system response from 4 Hz in record to 0.75 Hz in play. Potentiometer R275 is used to adjust the dc offset of the amplifier. Theoretically this control isn't necessary because the integrator compensates for the change. In practice this control is used to center the integrator voltage within its limits.

Adjustment of potentiometer R275 for play operation is rather difficult because the integrator voltage changes to compensate for variations in motor, transistor, torque, etc.

Under normal operating conditions the potentiometer is adjusted to center the integrator voltage within the limits of the integrator. The voltage is measured at TP205. (The approximate setting in the PLAY/STANDBY mode should be 2.5 volts.) When the adjustment is made in this manner the voltage will not exceed the limits under extreme operating conditions. A rise of 1.5 volts from tape not threaded to tape being played can be expected. Likewise a 1.5 volt decrease can be expected from a cold to a hot motor. Repeated stalling of the motor, by holding the drum, or by turning the motor off and on, causes a rapid increase in heat. Operating the unit in the standby mode cools the motor.

The output of the DC amplifier is connected to pin 7 of the servo board, which connects to the motor control amplifier. The output of the motor control connects to the drum motor through pin 1 of J607.

CAUTION

Do not stall the motor for more than 10 seconds or the motor will overheat and can be permanently damaged.

BIAS AND ERASE OSCILLATOR FUNCTION

The servo board houses the erase oscillator circuit. Oscillator operation occurs when the unit is placed in video/audio record. A nominal 60 volt bias signal at 67 KHz is supplied to the audio record head.

BIAS AND ERASE OSCILLATOR CIRCUIT DESCRIPTION

Two transistors, Q226 and Q227, make up the push-pull oscillator circuit. Operation is started when switch S102 is placed in the record position. The switch completes the path from the base circuit of the transistors to the +18V source. Transformer T201 provides the collector load, and can be tuned over a narrow range. It is important to have this transformer tuned to 67 KHz.

VIDEO HEAD DRIVER AND RF PREAMPLIFIER CIRCUIT FUNCTION

During the record-standby and record mode the head driver circuit receives FM information from the modulator circuit and amplifies this signal for use by the video head, which is located in the rotating drum. An FM signal is also fed back to the demodulator from the head driver. This is the E to E signal that is routed through the system to permit a performance test of the circuit functions without the use of a tape. During play operation the signal induced in the video head is coupled to the RF preamplifier. This circuit amplifies and equalizes the signal to be fed to the demodulator for playback.

VIDEO HEAD DRIVER AND RF PREAMPLIFIER RECORD CIRCUIT DESCRIPTION

The push-pull signal at pins J and H (J701) is coupled to driver transistors Q301 and Q308. Pin "k" serves as the center tap for the push-pull output. Potentiometer R301 provides the means for adjusting the emitter bias of this stage and therefore the output. Amplified output signals are coupled to the driver transformer T301 where it is matched for operation of the video head. The signal path to the head is completed through contact "a" on K301 during record operation. Contact "b" of the relay connects the other side of the head to R306 to develop the E-E signal.

VIDEO HEAD DRIVER AND RF PREAMPLIFIER PLAYBACK CIRCUIT DESCRIPTION

Playback signals induced in the video head are coupled to the bases of transistors Q302 and Q303, which are connected as a differential amplifier. From a service standpoint, rejection of equal amplitude coincident signals is implied, however, the degree of rejection depends primarily on the symmetry of the amplifier inputs. Thus, if the common mode rejection ratio is bad, check for small changes in resistance and capacitance.

The differential signal is coupled to an emitter follower Q304, and then to a grounded emitter stage Q305. Resonant circuit components L301 and C309 provide playback equalization. Adjustment of C309 is made to provide a playback signal that is the same as the record video signal. Resistor R309 provides damping to control the bandpass of the resonant circuit.

The equalized signal is routed to another grounded emitter amplifier for additional amplification, and then direct coupled through an emitter follower to pin B on the output connector. Isolation is provided by the emitter follower; and the low output impedance reduces the capacitive effect of the interconnecting cable to the demodulator circuit. This is necessary to prevent high frequency losses of the playback signal.

Diode CR301, in series with the winding of relay K301, allows the positive dc voltage (that is present at pin D of J701) to energize the relay when the recorder is in the record-standby or record mode.

AUDIO CIRCUIT (RECORD MODE) DESCRIPTION

In the record mode, the input signal is applied to terminal 6 of the slide switch S102 and to the base of preamplifier Q101. An equalizer and feedback circuit in the emitter leg of the transistor operates in the PLAY mode only. Output from this stage is fed to the base of Q102. This is an emitter follower stage with its output coupled to another contact on slide switch S101. Contacts on the switch couple the signal to the AUDIO RECORD LEVEL control in this mode and the base of amplifier Q103. Output from this stage is direct coupled to an emitter

follower Q104. The emitter output is coupled to the audio output jack (J802) through pin 13 of J603. Contacts on switch S101 unground E102;ac bias is applied to the head. Capacitor C111 feeds a portion of the output to the meter driver amplifiers Q106. Emitter bias is developed by transistor Q105. Record calibration is accomplished by varying R121 in the emitter of Q106.

AUDIO CIRCUIT (PLAY MODE) DESCRIPTION

In the PLAY mode, output from the audio head is coupled to base of the preamplifier Q101 through contacts of slide switch S101. Other contacts of switch S101 connect the equalizing and feedback networks to the emitter of Q101. Output of Q101 is coupled to the emitter follower Q102 and then to the base of amplifier Q103 through contacts of switch S101. This common emitter stage feeds the signal to another emitter follower and to the monitor circuits through pin 13 of J603. The meter circuits develop a dc voltage that is proportional to the audio signal and is applied to the meter to indicate play level.

MONITOR AMPLIFIER CIRCUIT FUNCTION

The monitor amplifier receives an audio signal from the audio board and converts it to an adequate power level for driving a speaker.

MONITOR AMPLIFIER CIRCUIT DESCRIPTION

The input signal applied to the input transistor Q901 is amplified and coupled to a pre-driver stage Q902, which is a common emitter circuit. The collector circuit of this stage is direct coupled to the driver stage Q904, which drives output transistor Q906. The other driver is a PNP-type and is series connected to provide the opposite phase for the other output transistor Q905 to provide push-pull operation. The advantage of complementary symmetry makes it possible to secure high gain as well as the push-pull operation without disturbing the bias circuit. This circuit takes advantage of tandem coupling and complementary symmetry to eliminate coupling capacitors and transformers with their inherent frequency selective characteristics.

FAILURE ANALYSIS

Failure analysis of the monitor output generally will fall into one of three categories: (1) no output (2) low output and (3) distorted output. No output is usually caused by an open or short circuit, or defective transistor. Use a VTVM and check the circuit resistance and transistor forward-reverse resistance. Low output indicates improper bias, which can be checked through a voltage analysis. Distortion can result from improper bias or changes in RC components. A scope will generally reveal the circuit that is introducing distortion.

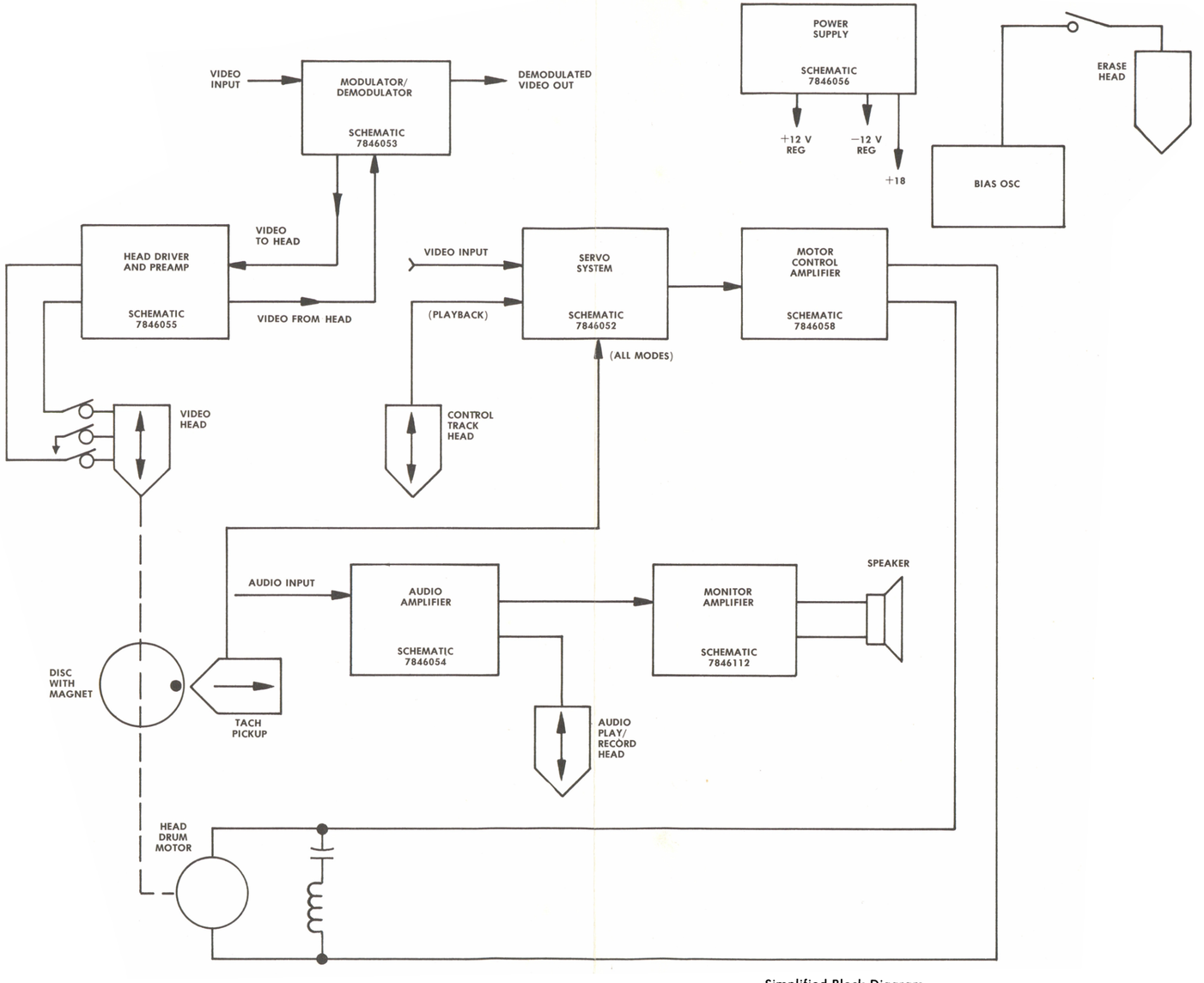
POWER SUPPLY CIRCUIT FUNCTION

Two basic power supplies are employed to provide the dc voltages for operating all of the circuits of the recorder and the drum motor. The transformer and rectifiers of one supply make up one subassembly. This supply furnishes the operating voltage for the monitor amplifier and the motor control amplifier. This same transformer provides the energy for the second supply, which is located on a separate subassembly. The other supply provides +18v, −12v, and +12v, and is controlled by a section on the Mod-Demod board. The +21v output is referenced to the −12v line.

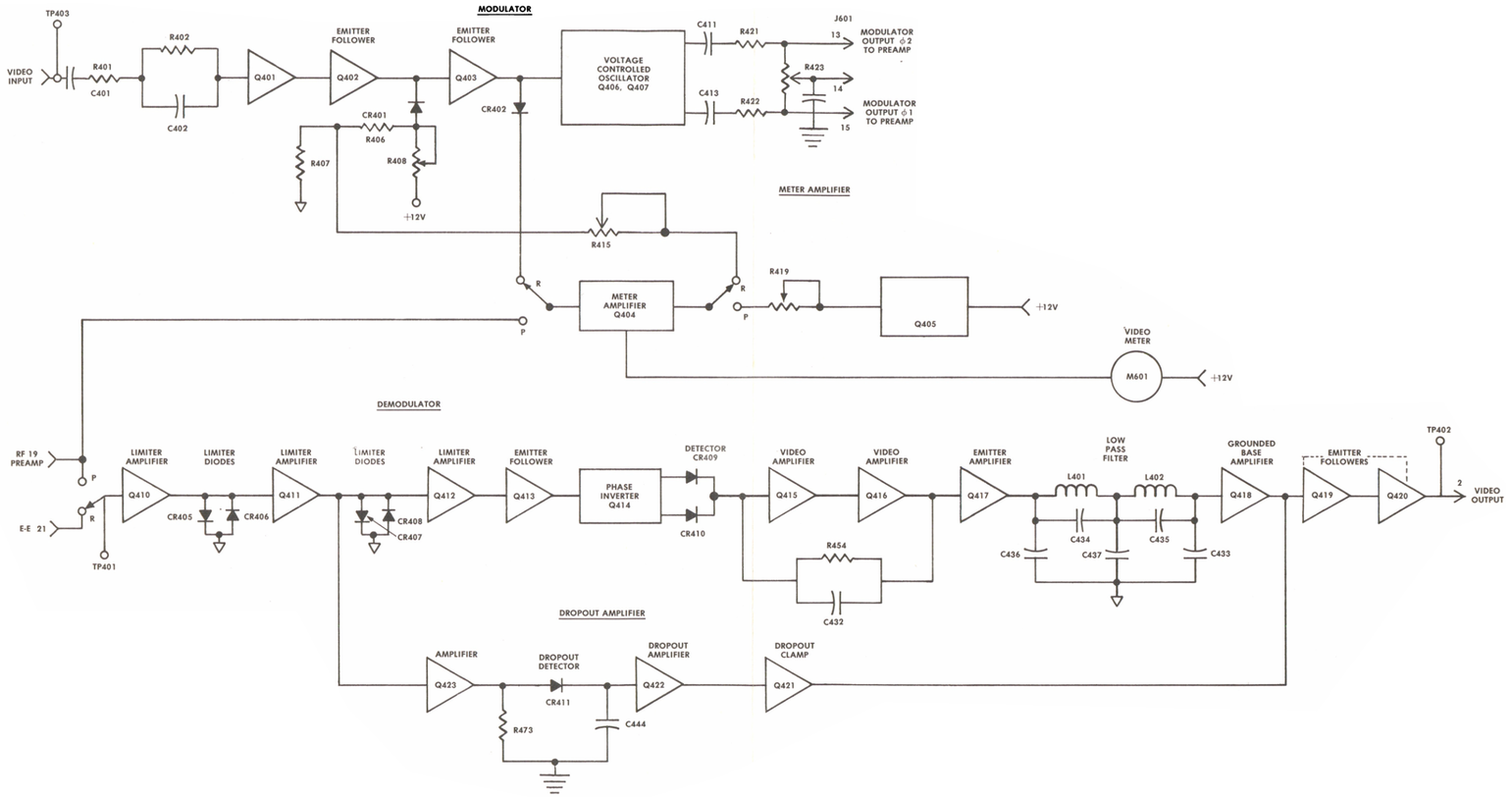
POWER SUPPLY CIRCUIT DESCRIPTION

Two rectifiers, CR601 and CR602, provide the full-wave output, which is filtered by capacitor C604. One lead of the positive output terminates at jack J606 on the monitor board. Another line from this output goes to the collectors of the motor control transistors.

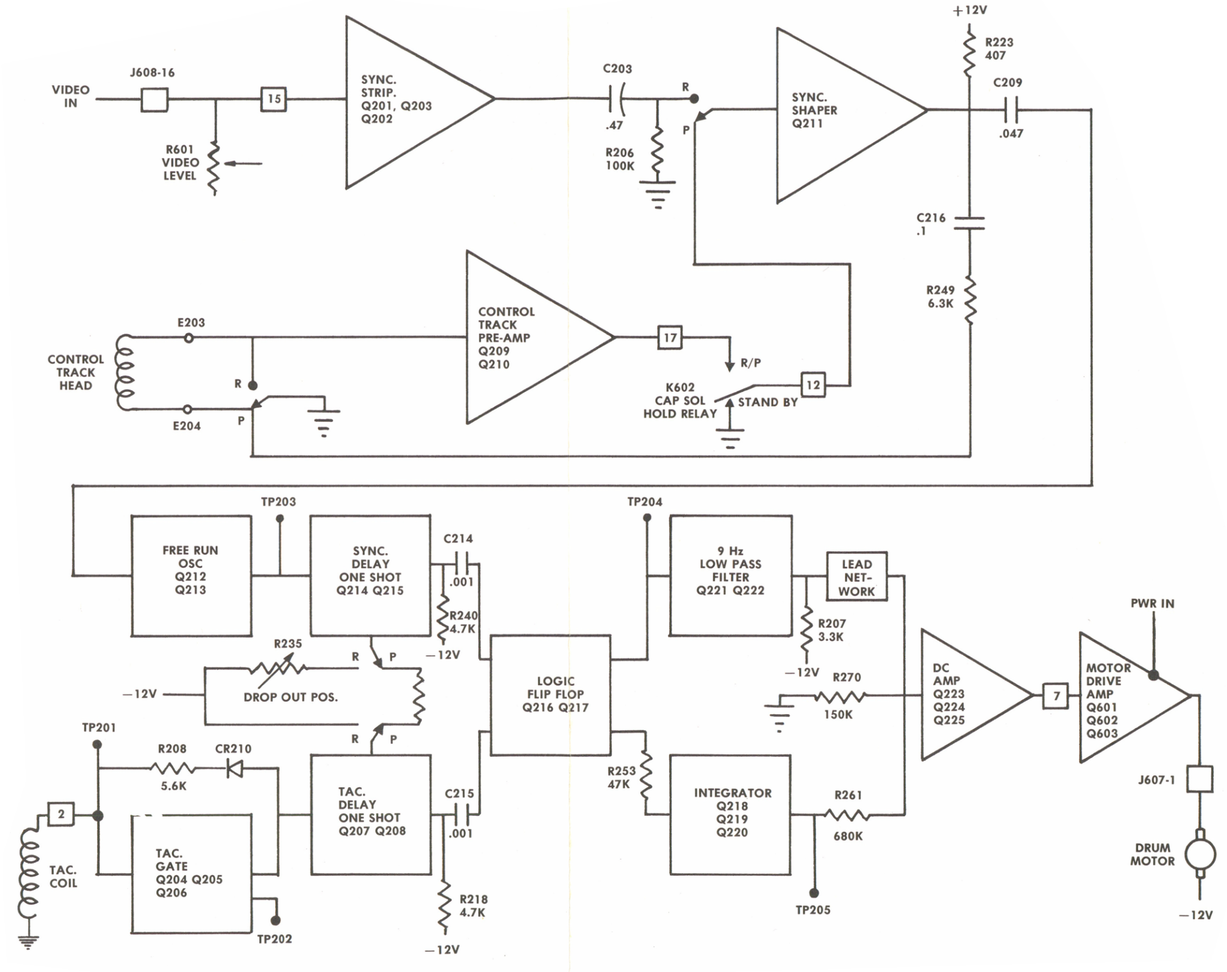
Rectifiers for the other power supply are located on the power supply subassembly which is on the rear side of the electronic chassis. The winding of the transformer connects to CR501 and CR502 through pins on P601. A large capacitor (C501) provides ripple reduction for the full-wave output before it is connected to the series regulator transistor Q501. The +18v line connects to pin 5 of J606. Diodes CR503 and CR504 provide the reference voltage for the series regulator. The collector of the series regulator connects to pin 9 of J606. Transistors Q502 and Q503 provide a shunt regulating function. Q502 is in the +12v output while Q503 is in the −12v side. Capacitors C502 and C503 provide additional filtering to both outputs.



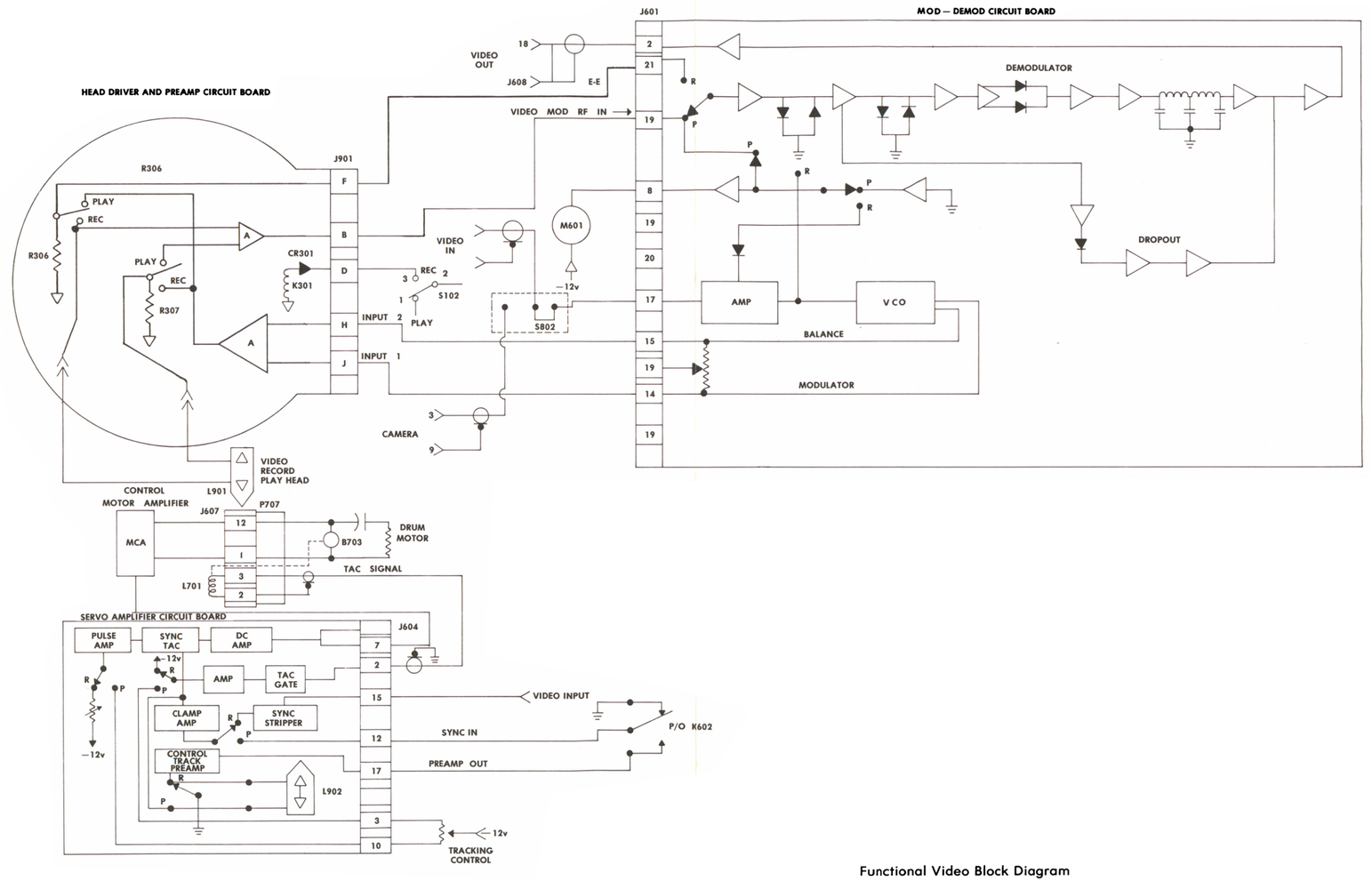
Simplified Block Diagram



Mod-Demod Block Diagram



Functional Servo Operation



Functional Video Block Diagram

MECHANICAL REPAIRS AND ADJUSTMENTS

GENERAL INFORMATION

Preventive maintenance will keep the equipment in peak operating condition and reduce the possibility of major failure. These procedures should be performed when the equipment is in for repair.

Cleanliness will ensure trouble-free, faithful performance of the equipment. Cleaning the heads, slip rings, tape guide components and capstan can prevent tape flutter and poor frequency response. Belts should be replaced when they have stretched or worn. The video head should be checked for proper tip projection; and the turntable hold-back tension, take-up torque, rewind torque, speed and wow and flutter should be checked to prolong the useful operating life of the recorder. The tape guides will not require adjustment unless abused.

The periodic maintenance procedures include the required mechanical checks and adjustments.

To gain access to mechanical components located beneath the cover plate, proceed as follows:

TRIM PANEL REMOVAL

1. Pull the REWIND-FAST FORWARD and READY-THREAD knobs off.

2. Remove the TENSION, AUDIO RECORD LEVEL, VIDEO RECORD LEVEL, TRACKING, and VOLUME knobs.

3. Remove the four nuts from the controls and remove the control panel.

4. Remove the four Phillips screws that secure cover plate to transport. (See Figure 5-1).

5. Remove the tension arm and tension arm stop. Each has a single Phillips head screw. (See Figure 5-1).

6. Remove drum guard collar by pressing front ends of collar inward, and then lifting it out. (See Fig. 5-10)

7. Lift cover plate off.

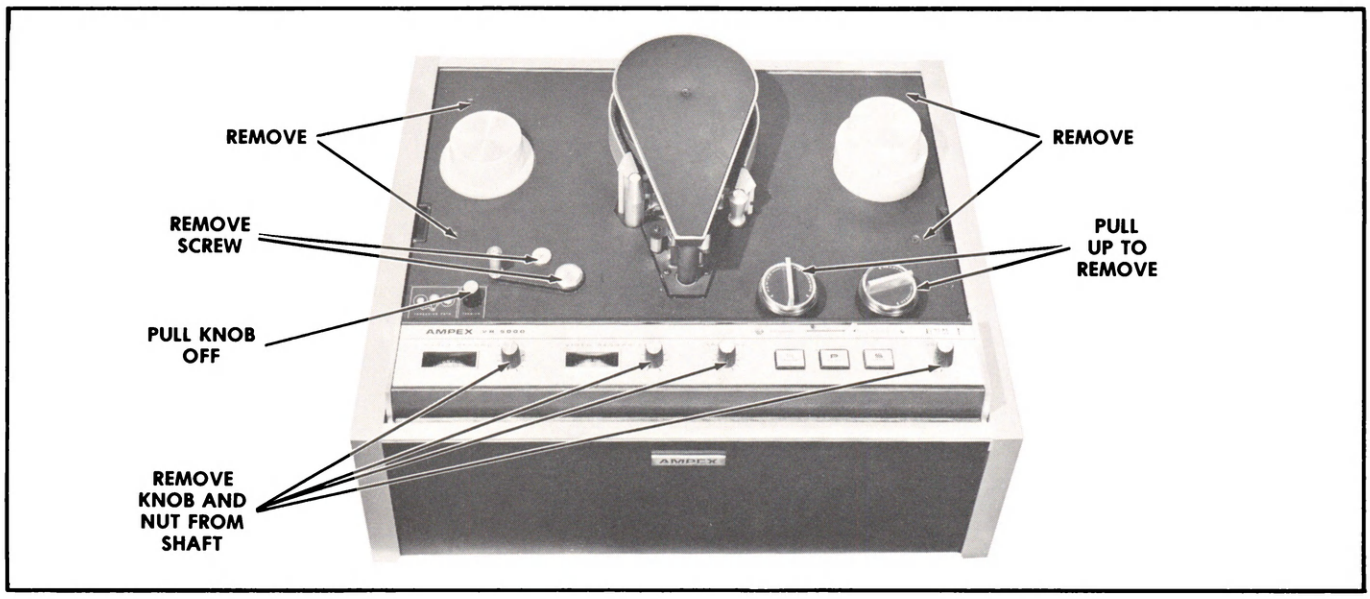


Figure 5-1. Removing Transport Cover Panel

CASE REMOVAL

To remove the recorder from the case, proceed as follows:

1. Remove all connectors from the rear panel.

2. Turn the unit over on its side to make the cabinet feet on the bottom of the case accessible.

3. Remove the four screws (Figure 5-2) holding the cabinet feet to the case.

4. Pull the case cover off by sliding gently forward.

NOTE

Cover must be pulled off evenly to prevent binding.

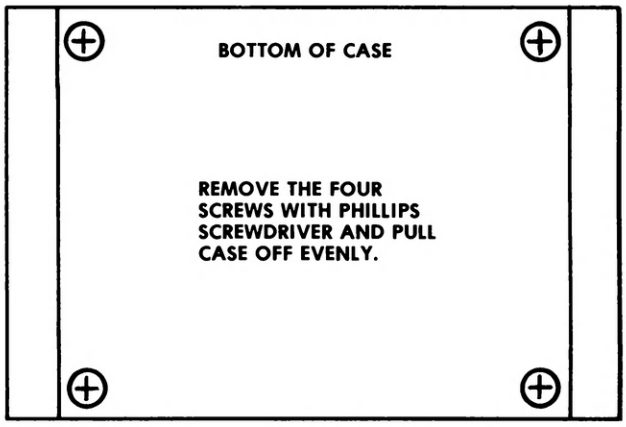


Figure 5-2. Removing The Case

EQUIPMENT REQUIRED FOR MECHANICAL ADJUSTMENTS

The following equipment must be available for mechanical checkout and adjustment of the recorder:

1. Spring Gauge (0-30 oz.)
2. Miscellaneous Phillips and blade-type Screwdrivers.
3. Bristol Wrenches.
4. Assorted open end wrenches and nut drivers
5. Projection tool (Ampex P/N 7956001-01)
6. Projection gauge (Ampex P/N 7036026-1N4)
7. Ampex Head Cleaner (Ampex P/N 7010823-01)
8. Alcohol (for cleaning capstan)
9. Cotton tipped swabs (purchased at any drug store)
10. Reel with 6 in. tape pack
11. Contouring Tape (Ampex P/N 7956005-01 5 minutes, 7956005-02 15 minutes).

CAUTION

NEVER LIFT THE RECORDER BY THE VIDEO HEAD DRUM COVER ASSEMBLY THIS ACTION WILL DAMAGE THE BRUSH ASSEMBLY AND COVER.

TENSION ADJUSTMENTS

TORQUE MEASUREMENT FUNDAMENTALS

Torque is a measured force multiplied by the distance between the point of measurement and a pivot point. For example, 5 in./oz. of torque is a force of 5 oz. at 1 inch from the pivot point. A wheel 3 inches in diameter requiring 2½ oz. of pull to move or prevent from moving, represents a torque of 3.75 in./oz. (1.5 × 2.5). In the case of an arm or rod, the force required to move or hold the arm stationary must be measured at right angles to the arms or rod. Otherwise, torque measurement will be erroneous. In addition, friction and/or inertia must at times be overcome. Therefore, when measuring holdback and take-up torque, move the reel slowly in the direction of reel take-up by pulling gauge to relieve friction. The torque indications will be different when the gauge is held stationary and when the gauge is just moving.

TAKE-UP TORQUE ADJUSTMENT

The take-up reel torque in the Play mode of operation is 45 to 65 in./oz. To check take-up torque, perform the following steps:

1. Place a reel of tape, having a 6" tape pack diameter, on the take-up turntable. Reel must seat properly on the turntable.
2. Connect the recorder to AC power and turn it "ON."
3. Connect a spring gauge, capacity 0 to 30 oz. to the tape on the take-up reel. Fold tape end over and secure with splicing tape as shown in Figure 5-3.
4. Unwind about 4 feet of tape from the take-up reel and place the recorder in the PLAY mode. Allow the take-up reel to slowly wind the tape while noting the average indication on the spring gauge. If take-up torque is correct (45 to 65 in./oz.), the gauge should indicate 15 to 21.6 oz., with a 6 inch diameter tape pack.
5. If the take-up torque is low or erratic, check for drive tire slip. To perform this check, place the recorder in the PLAY mode and stop the take-up turntable from rotating. The take-up reel drive tire should continue to rotate with all slippage occuring in the clutch. (See Figure 5-7). If the slippage does not occur in the clutch, clean the tire surface and the take-up drive idler (delrin part) with alcohol. Recheck drive tire slip. If the drive tire is not slipping and the take-up torque is low, remove the "C" ring and spring (Figure 5-8). Place another shim on the clutch plate, replace spring, "C" ring and check tension. If low tension persists, add another shim. If tension is abnormally high, remove shims until it is correct.

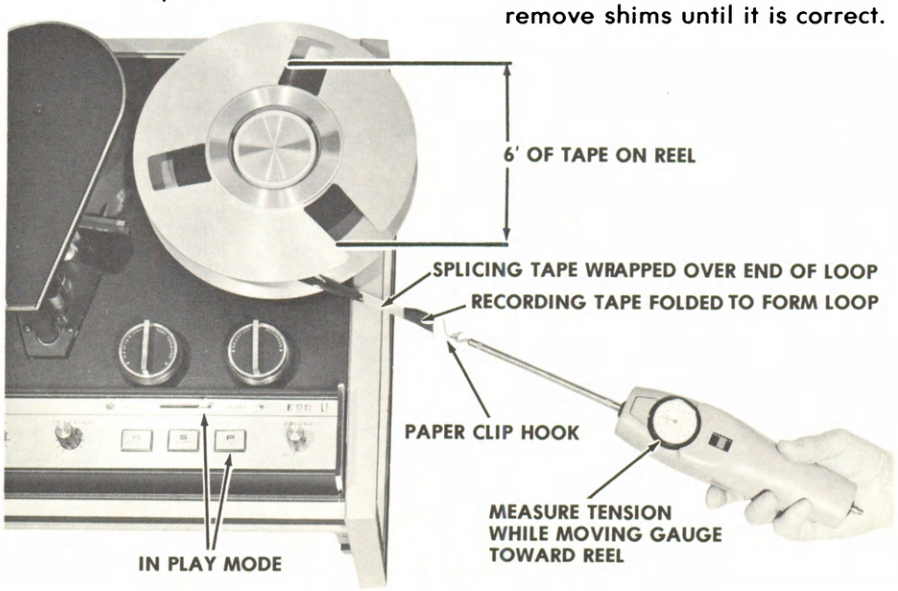


Figure 5-3. Take-up Torque

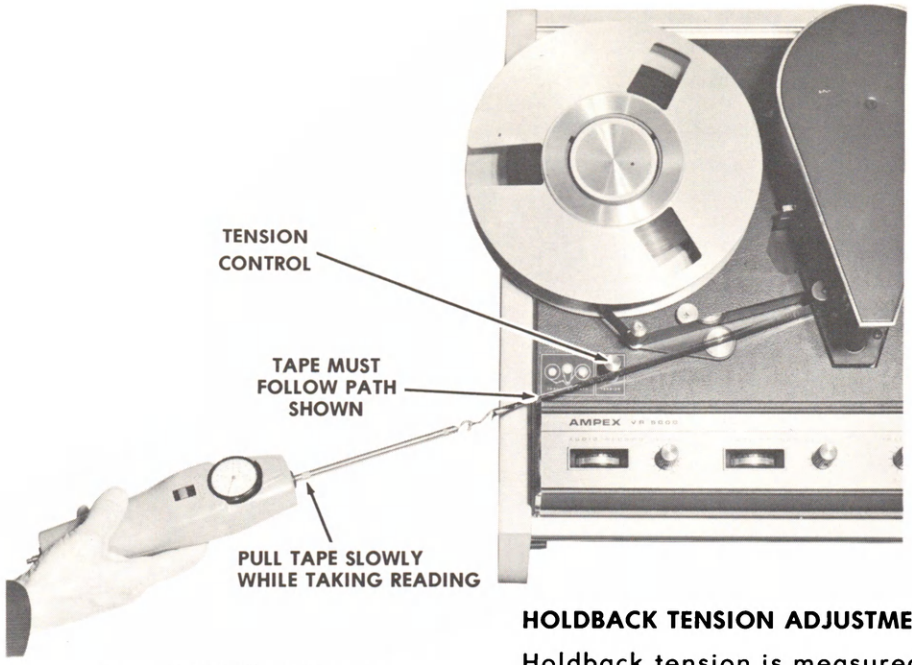


Figure 5-4. Holdback Torque

REWIND TORQUE ADJUSTMENT

When the recorder is in the rewind mode, the rewind torque measured on the supply reel should be between 55 and 70 in./oz. Make measurement and adjustment in the same manner as take-up torque (Figure 5-3) with the recorder in the REWIND mode. A 6" diameter tape pack, should give an 18.3 to 23.3 oz. torque. Add or subtract shims from the clutch plate (Figure 5-8) to correct. If torque is low or erratic, check for drive tire slip as described for the take-up drive.

HOLDBACK TENSION ADJUSTMENT

Holdback tension is measured by pulling tape through the path shown in Figure 5-4. With the tension control counterclockwise, the holdback tension should be between 8 and 9½ oz. With the control fully clockwise holdback tension should be 1½-2½ oz. Holdback tension is adjusted by rotating the lock nut shown in Figure 5-5. Holdback tension is increased by clockwise rotation of the locknut and decreased by counterclockwise rotation of the locknut.

For holdback tension, take two measurements:

1. Hold tension control fully counterclockwise, read gauge while slowly pulling tape from teel.

2. Hold tension control fully clockwise, read gauge while slowly pulling tape from reel.

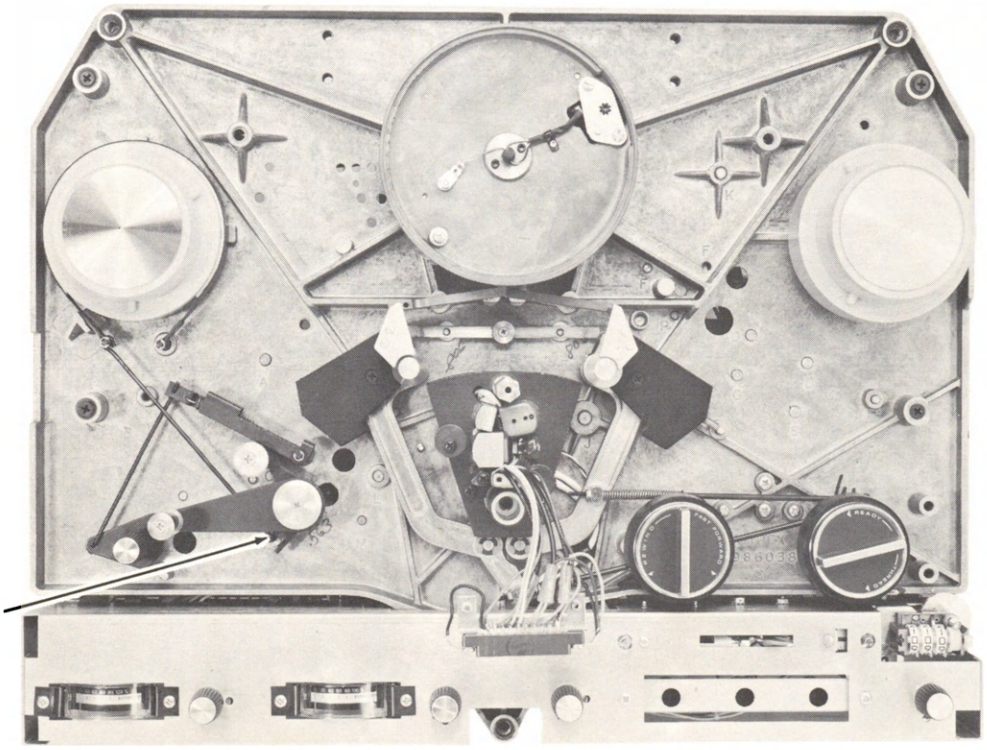


Figure 5-5 Holdback Tension Adjustment

HOLDBACK TENSION RELEASE CLEARANCE

After adjusting holdback tension, the clearance of the holdback tension release mechanism should be checked. Refer to Figure 5-6. This clearance must be checked with the F/FWD-REWIND control in the "OFF" position. Excessive clearance causes inadequate brake release and sluggish forward wind. Insufficient clearance prevents full holdback braking action and the recorder may spill tape when switched from the "Forward Wind" to "Stop" mode.

CHECKING LONGITUDINAL FLUTTER AND TAPE SPEED

See paragraph in Electrical Adjustments for detailed procedures.

ADJUSTMENT OF CAPSTAN DRIVE SYSTEM

Correct capstan drive pressure is essential for adequate capstan drive and low longitudinal tape flutter. This adjustment is made by rotating the self-locking nut on the play solenoid plunger (Figure 5-9). Rotating the nut clockwise increases the drive pressure; rotating it counterclockwise decreases the drive pressure.

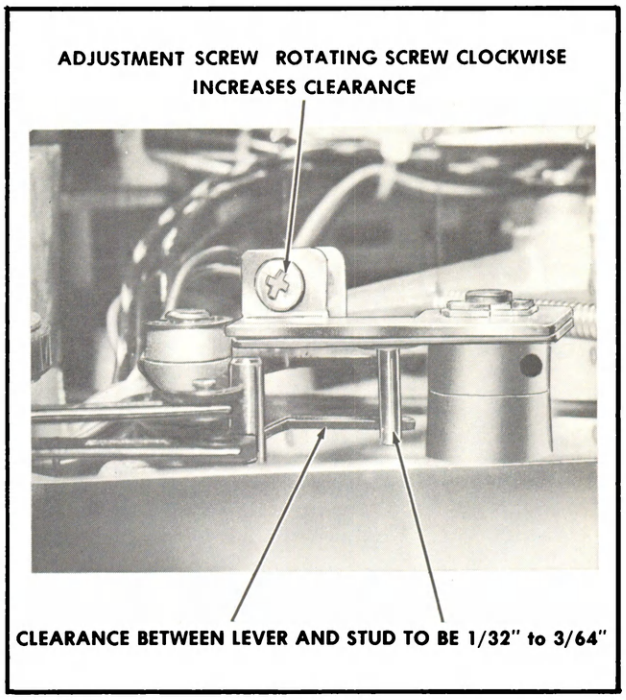


Figure 5-6. Adjustment of Holdback Tension-Release Clearance

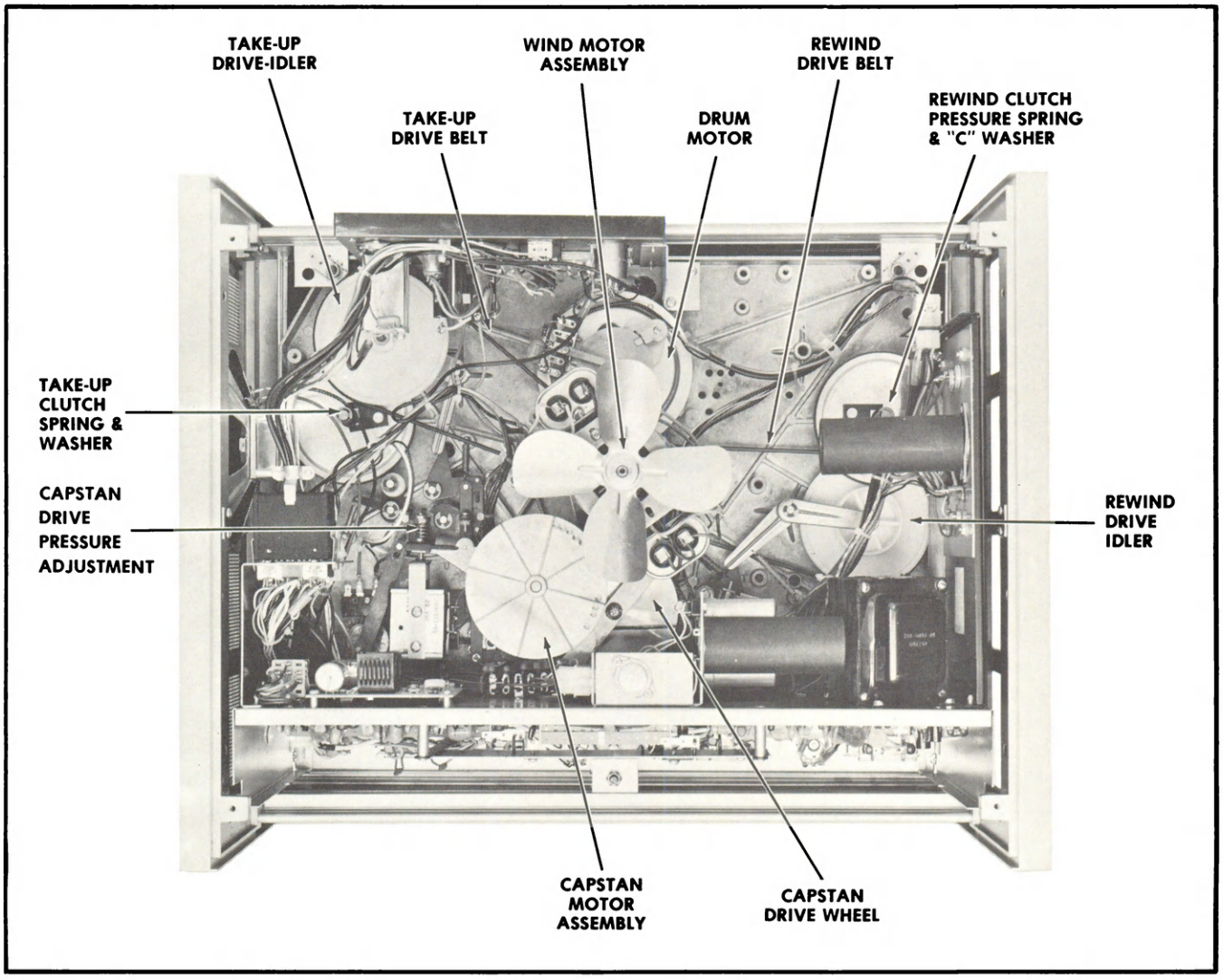


Figure 5-7. Location of Parts

The lower limit of acceptable capstan drive pressure can be determined as follows: Clean the capstan tape drive surface, thread tape on the recorder, and attain the condition of a near empty supply reel and a full take-up reel. Set the tension control to maximum. If, under these conditions, the recorder will reliably start transporting tape when it is placed in the play mode, the capstan drive is adequate.

Increasing the capstan drive pressure from the minimum acceptable value will increase longitudinal flutter. After the capstan drive pressure adjustment, the clearance (in the play mode) of the take-up drive engagement mechanism should be checked, it should be between .020" and .030" (Figure 5-9). This clearance can be adjusted by the screw on the motor plate retraction link. The adjustment effectively shortens or lengthens this link. The hex nut on this link functions as a lock nut and must be loosened before adjustment and retightened after adjustment.

After adjusting take-up drive clearance, recheck the capstan drive pressure adjustment. This is necessary as the two adjustments are not completely independent of one another. Check the stroke of the solenoid for 3/16" ±1/32". Adjust by loosening the two screws (Figure 5-9) that secure the plunger stop bracket; then reposition the bracket.

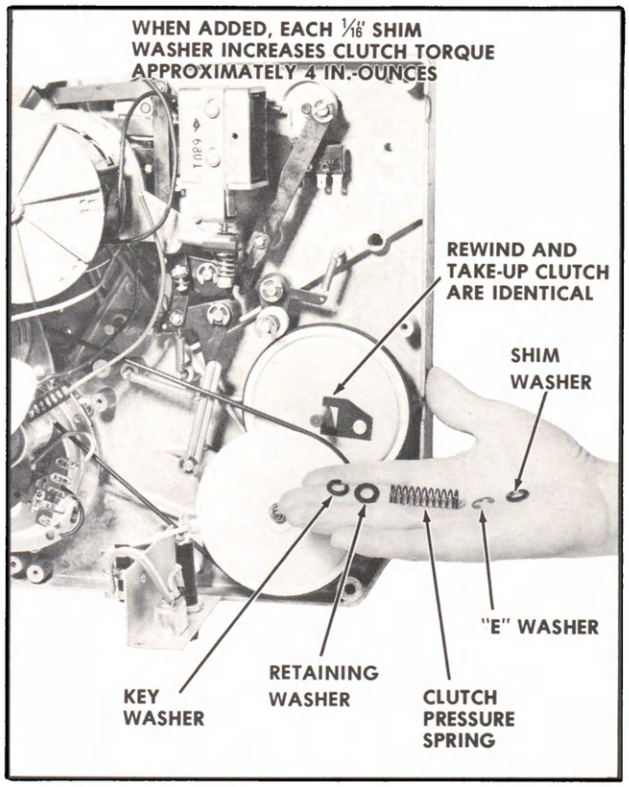


Figure 5-8. Clutch Adjustment

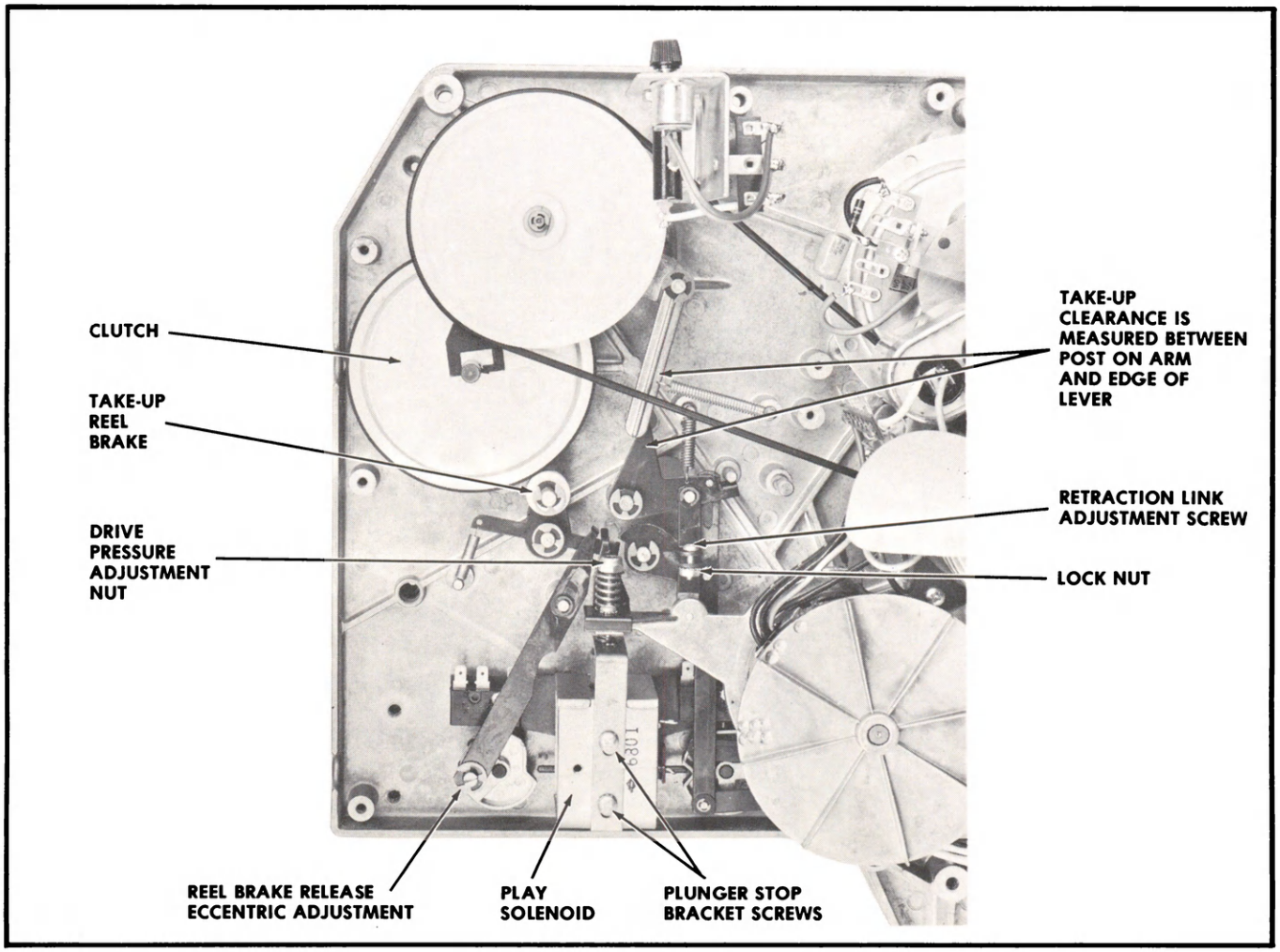


Figure 5-9. Capstan Drive Adjustment

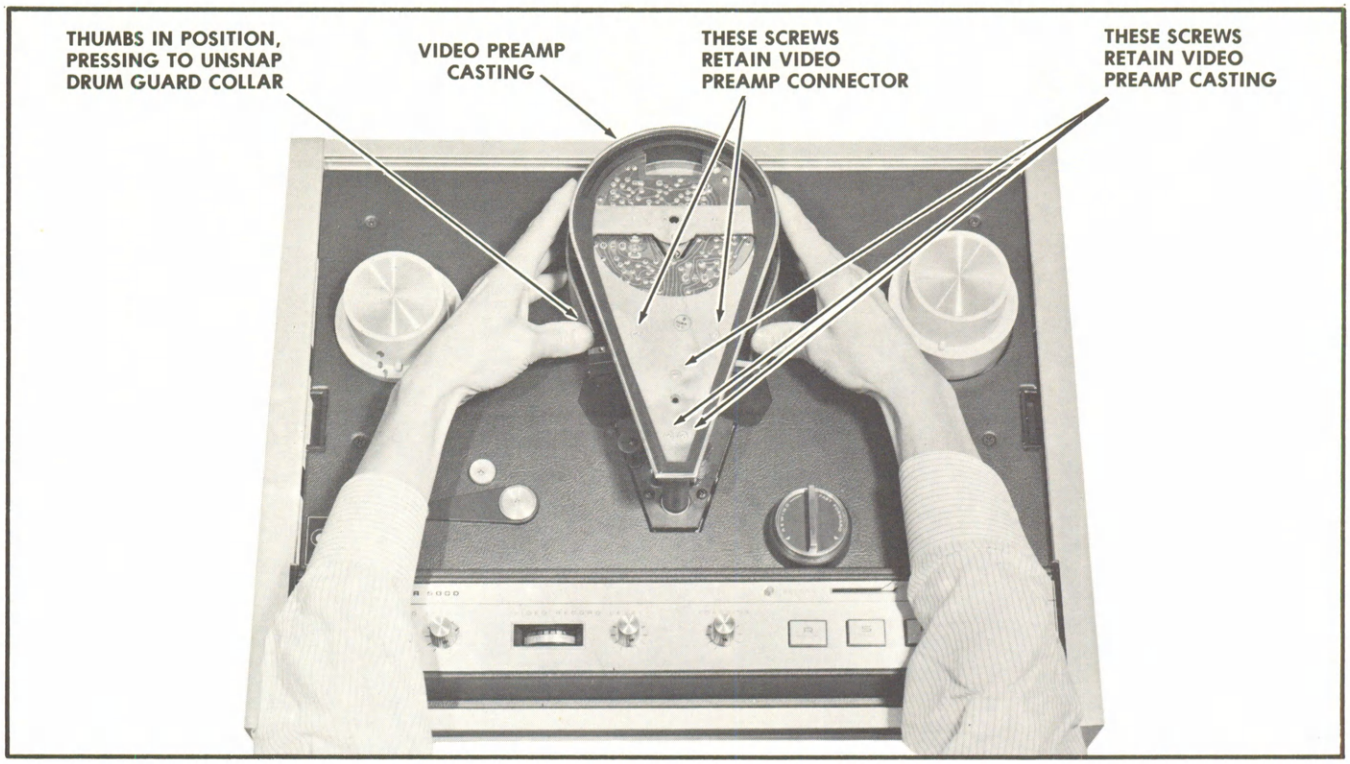


Figure 5-10. Removal of Preamp Casting

TAKE-UP REEL BRAKE RELEASE DURING THREADING

When the "Ready/Thread" control is in the "Thread" position, the brake on the take-up reel is released and is free to rotate to supply tape slack when the guides are closed. The mechanism that provides this function must be adjusted so that the take-up reel brake is reapplied as soon as the guides close (before the "Ready/Thread" control completes its motion). An eccentric adjustment is provided on this mechanism as shown in Figure 5-9. To adjust, hold the guides closed with the "Ready/Thread" control (the control is rotated to the point where the arms close and strong resistance is felt but not so far as to bring it to its over center or locked "Ready" position), and turn the eccentric until the brake just contacts the take-up drive tire. Late engagement of the brake will cause tape spill, while early engagement will cause the drum to stall.

REMOVAL AND REPLACEMENT OF VIDEO PREAMPLIFIER CASTING ASSEMBLY

Removal:

NOTE: Adhere to the following sequence:

1. Place the "Ready/Thread" control in the "Thread" position.

2. Remove the single Phillips head screw (Figure 5-10) in the center of the head cover plate and remove the head cover plate.

3. Remove the Drum Guard Collar as shown in Figure 5-10.

4. Remove the two screws closest to the video preamplifier board.

5. Reach underneath (with one finger of each hand) and pull the connector from the video preamplifier circuit board near the capstan. As soon as it releases, push it down between the open entrance and exit guides.

6. Remove the two smaller Phillips screws near the capstan. The preamplifier casting is now held by one large Phillips screw.

7. Place one hand around the drum and casting, holding it in place. With the other hand, remove the final screw.

8. While holding the casting with both hands, move casting slowly toward rear of transports while watching the brushes through the round hole in the center of the head board support bracket. As soon as the brushes have cleared the slip ring, lift the casting up and off.

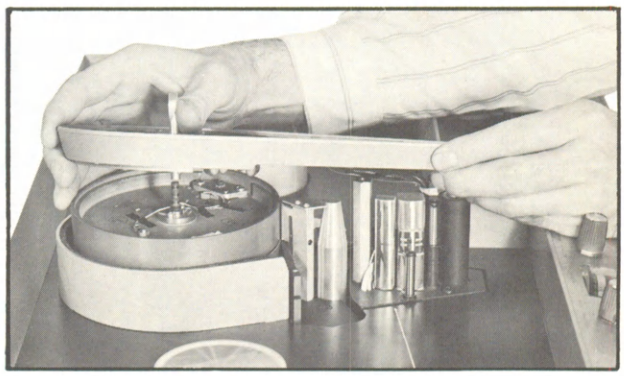


Figure 5-11. Installing Preamp Casting

Replacement:

1. Place the "Ready/Thread" control in the "Thread" position and place the video preamplifier board connector down between the open entrance and exit guides. Be sure the connector is not turned over and that none of the wires are crossing the connector supports. This will prevent pinched wires.

2. Slip the brush spreading tool in the hole between the two rows of brushes, moving them apart with the chisel-shaped portion of the tool (Figure 5-12).

3. While holding the brush tool in place, (see Figure 5-11) place the casting over the slip ring and slowly lower the casting and tool over the slip ring assembly.

4. While holding the casting in place, replace the large center screw and tighten. After the casting is secured, remove the brush tool using a slight twisting and lifting motion.

5. Replace the two screws above the capstan and tighten them securely while observing the placement of the brush block in relation to the slip ring. The slip ring should be centered within the opening (Figure 5-13).

6. With one hand on either side of the casting, pick up the connector between the entrance and exit guides and push it over the end of the video preamplifier board. Align the two holes in the mounting brackets of the connector with the two holes in the casting.

7. Replace the two small Phillips screws that secure the connector to the casting.

8. Replace the head drum cover plate and secure it with the black Phillips head screw.

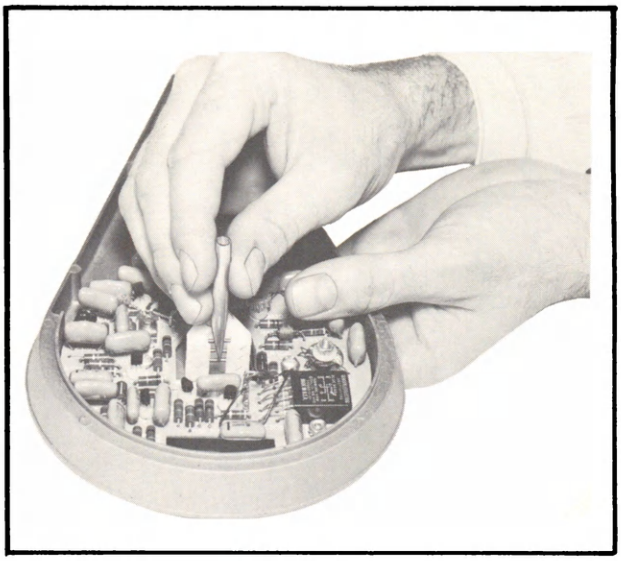


Figure 5-12. Inserting Brush Tool

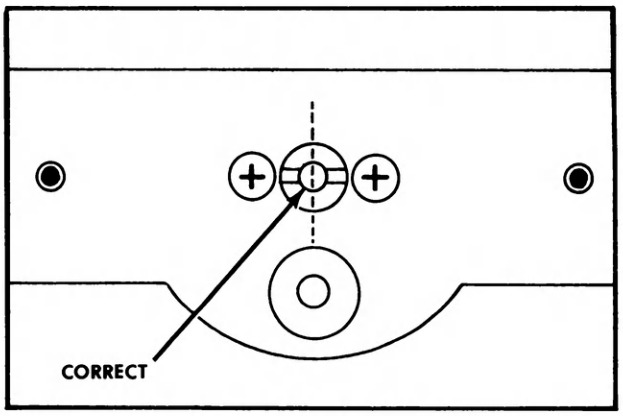


Figure 5-13. Brush Alignment

REPLACING VIDEO HEAD

1. Remove head cover trim plate and drum guard collar as described on page 5-6.

NOTE

Video head can be replaced without removing preamplifier casting. Instructions for removing the head in this manner are included with the head replacement kit.

2. If it is desired to remove the preamplifier casting, proceed as described on page 5-6.

3. Gently pull the cable socket (Item 1, Figure 5-14) up and away from the video head with a pair of long-nosed pliers.

4. Remove the two slotted brass screws (Item 3, Figure 5-14) and carefully lift out the video head and mounting plate assembly.

5. The video head is held to the mounting plate by a bristol head cap screw (See Figure 5-15). Remove this screw and the old head. Before mounting the new video head, make a note of the number marked on the head; it indicates gap depth. Refer to Step 10.

NOTE

When mounting video head on mounting plate be sure spring ends are positioned as shown in Figure 5-15. Before tightening bristol screw, push head as far back as possible. Refer Figure 5-15.

6. Remount the video head assembly to the rotating upper drum and reconnect the cable socket to the video head.

7. Place the protruding edge of the projection tool (Item 5, Figure 5-14) over the top edge of the upper drum, directly in line with the video head. While holding the tool firmly in place, loosen the bristol cap screw (Item 6, Figure 5-14) one half turn and retighten. This will allow the spring to project the head against the tip projection tool.

8. If a tip projection dial indicator gauge is available, check projection as follows. See Figure 5-16 for placement of the tip projection gauge. While holding the gauge in one hand, rotate the upper drum until the video head is to either side of the gauge plunger. At this point calibrate the gauge for zero. Rotate the upper drum so that the video

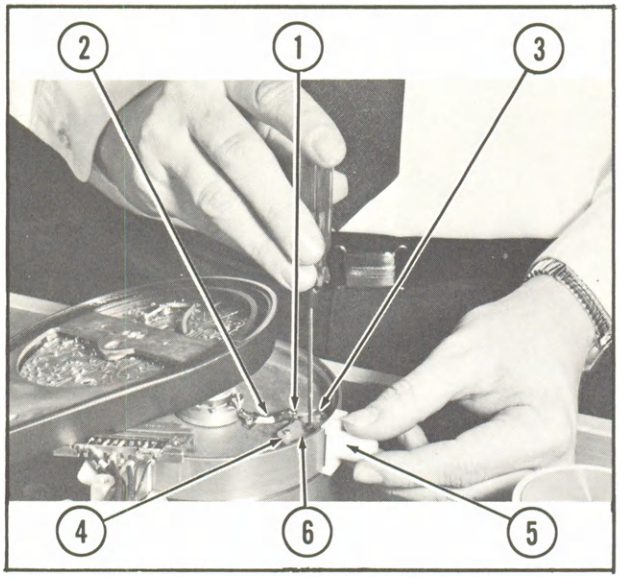


Figure 5-14. Steps for removing video head mounting plate assembly and proper position of tip projection tool.

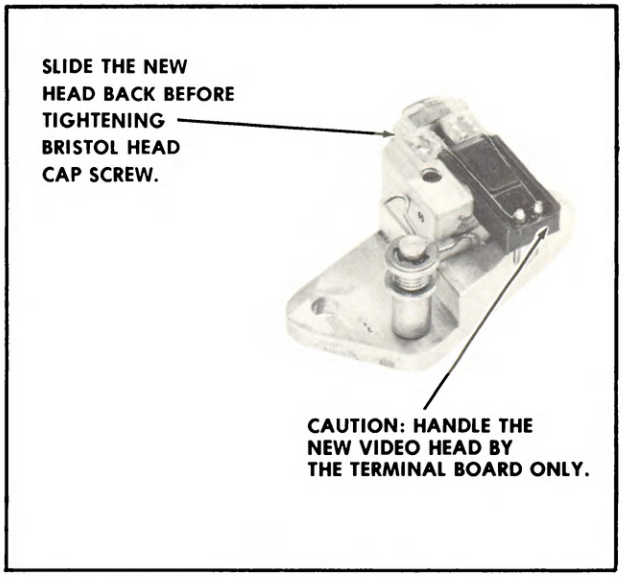


Figure 5-15. Bottom view of video head mounting plate assembly.

head rides under the gauge plunger. Reading should be approximately .003 to .004 thousandths of an inch.

9. Replace the preamplifier casting as described on page 5-7, but for the time being do not replace the head drum cover plate.

10. Head Contouring

After a new video head is installed in the recorder, it is necessary to contour the head before it will record or playback satisfactorily. This is accomplished by running a reel of contouring tape on the recorder. Contouring shapes the front of the head for optimum head to tape contact and also reduces the gap depth. Normally the VR5000 will produce a satisfactory signal when the gap depth is less than .0035 inch and as the gap depth is further reduced, the head output and recorder signal to noise ratio increases. It is important to realize however, that a smaller gap depth means that there is less life available in the head and thus, VR5000 heads are never contoured in the plant to less than .002 in gap depth.

The initial gap depth is marked on the head in ten thousandths of an inch. For example, a head marked 41 has a gap depth of .0041 inch.

Many of the video heads in the field have gap depths that are greater than the .0035 and thus, in the case of such a head, the gap depth must be reduced by the contouring process.

If a dial indicator tip projection gauge is available, the amount of gap depth reduction can be determined by taking readings before and after contouring. Thus, the gap depth after contouring equals the initial gap depth minus the gap depth reduction.

If a dial indicator tip projection gauge is not available, it is suggested that the contouring tape be run for no longer than 30 seconds at a time and then the head performance checked as described in Step 11. This process may be repeated several times if satisfactory head output is not achieved. In cases where more than .001 in. of material is removed, it is necessary to reset tip projection.

Recent video heads have been manufactured with initial gap depths less than .0035 inch. Such heads require less contouring as it is only necessary to shape the front of the head. Therefore, these heads should only be contoured for 15 seconds and then the head output checked as described in Step 11.

11. Checking Video Head Output

Check to see that the record head drive TP302 is set at 18 volts P.P. (Use 10:1 probe on scope for all measurements in this section.) If not, adjust R301 until this is the case. Then make a recording and check the resulting playback level at TP401. The level should be 0.8 volt P-P or greater.

LUBRICATION

Under normal operation conditions lubrication is not required. All bearings are either of the oilite type or permanently lubricated ball bearings. No attempt should be made to relubricate the ball bearing. If relubrication of the oilite bearings is considered necessary because of unusual conditions, use one drop of Ampex lubrication oil, P/N 7010825. Oil must not splash from rotating parts onto other parts (do not allow oil to contact rubber parts).

Figure 5-16. Proper position of tip projection gauge.

CAPSTAN REPLACEMENT

To replace the capstan in the recorder, proceed as follows:

1. Remove the recorder from its case.

2. Remove the video preamplifier casting assembly as described.

3. Place the recorder upside down, using 8 inch blocks at each side. This prevents damage to the recorder and will allow you to reach beneath the recorder to remove the capstan.

4. Loosen the set screw on hub of capstan drive wheel, with an 1/16" Allen wrench, until it protrudes about 1/8 inch.

NOTE

There is a steel ball at the lower end of the capstan. When proceeding with the next step, be sure it is not lost.

5. Reach beneath the recorder and pull the capstan straight down and out. Remove the steel ball and place it in a safe place. It must be reinstalled with the new capstan. Do not disturb the position of the capstan drive wheel.

6. Transfer the washer from the removed capstan to the new capstan.

7. Apply a single drop of oil, Ampex part number 7010825, on each of the capstan bearing surfaces.

8. Insert the capstan straight into the bearing and into the bore of the capstan drive wheel from beneath (the recorder is upside down) the recorder. Make sure the steel ball is in the cup at the end of the capstan shaft as the capstan is inserted.

9. Using an Allen wrench, tighten the set screw in the capstan drive wheel, making certain it seats in the dimple of the capstan shaft. The capstan should have a minimum of .005" end play. The end play is adjusted by rotating the Phillips head screw at the bottom of the capstan shaft thrust bearing. There is a lock nut that must be loosened before the screw can be rotated.

10. Place the recorder top side up. Mount the video preamplifier casting.

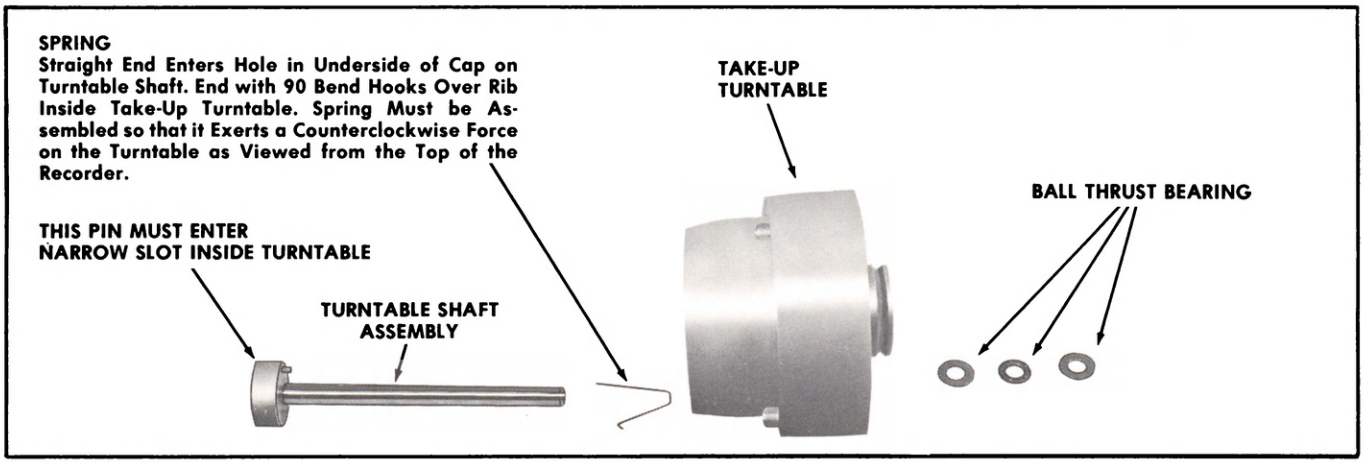


Figure 5-17. Tape Slackener Parts

TAPE SLACKENER MECHANISM

A tape slackener mechanism is built into the hub of the take-up turntable. It is necessary to take up slack and position the tape by manually rotating the supply turntable to still frame. The parts of the slackener mechanism are illustrated in Figure 5-18. If disassembled, the spring must be located correctly. The position of this spring can be checked by viewing the turntable assembly from its bottom side. Proper placement is shown in Figure 5-19.

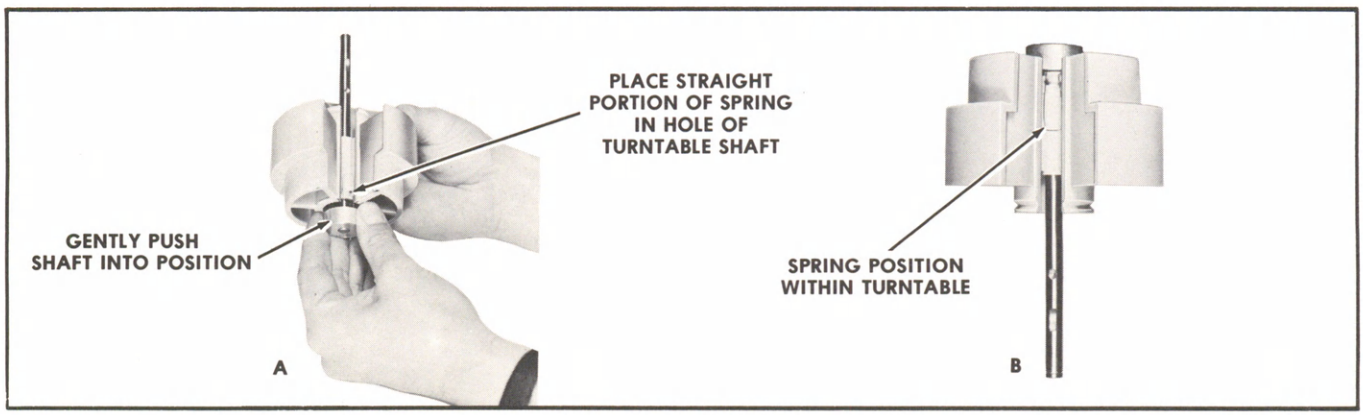


Figure 5-18. Spring Position in Tape Slackener Mechanism

ELECTRICAL ADJUSTMENTS

The following paragraphs provide an operational check-out, and electrical adjustments. To make all electrical adjustments, use the following instructions in sequence. If an adjustment of a particular portion of the recorder is required, refer to the paragraph describing that adjustment only. Before making any adjustments, check the power supply voltages. If the Mod-Demod circuit board has been replaced it may be necessary to set the regulator voltages and realign the servo before making any other adjustments. All tests and adjustments must be made with the recorder in a horizontal operating position.

EQUIPMENT REQUIRED

1. Triggered Sweep Oscilloscope, sensitivity .005V/CM, DC to 10MHz.
2. Sine wave generator, 1% or less distortion, 30Hz to 10MHz or crystals covering the frequencies required.
3. Television monitor capable of 800 line resolution and under scan.
4. D.C. high impedance Voltmeter.
5. A.C. VTVM.
6. A TR-821 monitor or vidicon camera.
7. Low capacity oscilloscope probe (10:1 divider).
8. Flutter meter.
9. Frequency counter.
10. Projection gauge (Ampex P/N 7956001-01).
11. Setting gauge (Ampex P/N 7036026-1N4).
12. Ampex Head Cleaner (Ampex P/N 7010823-01).
13. Cotton tipped swabs (purchased at any drug store).
14. A shielded 51K ohm, 1/2W., 10% resistor.
15. A 200-250 pfd., 25V. capacitor.
16. Reel of blank 1 inch mylar recording tape Ampex series 147 or equivalent.

OPERATIONAL CHECKOUT

1. Connect the AC Power cable and place the video switch on the rear panel to VIDEO IN.
2. Turn AC Power ON; recorder power lamp should light.
3. Place Rewind control in NEUTRAL and Ready control in THREAD. With RECORD-PLAY lever in PLAY, depress Record, Play and Stop pushbuttons; the take up reels should not rotate.
4. Place Ready control in READY. Depress Play and after a few moments depress Stop pushbutton. The capstan and take up reel should rotate and then stop.
5. Depress record interlock and move RECORD-PLAY lever to RECORD. Depress Record and Stop pushbuttons. The Capstan and Takeup reel should rotate and then stop. Record lamp should light and then go off.
6. With the record play lever in the RECORD mode, depress RECORD pushbutton and then turn the Rewind control to FAST-FORWARD. Capstan and takeup reel should rotate, record lamp should light. In FAST-FORWARD the capstan stops, record light goes off, Takeup reel speeds up and the RECORD-PLAY lever automatically returns to the PLAY position.
7. Reset Rewind control to NEUTRAL; RECORD-PLAY lever to RECORD and depress the Record pushbutton. Turn Rewind control to REWIND. The capstan and Takeup reel rotate, record lamp lights. In REWIND the capstan and Takeup reel stop, record light goes off, supply reel rotates and the RECORD-PLAY lever automatically goes to the PLAY position.
8. Depress Play pushbutton. Set tension control fully CW and depress Stop pushbutton. The tension control will return to center when Stop is depressed.
9. Depress Play pushbutton. Set tension control fully CCW and depress stop pushbutton. Tension control will return to center when Stop is depressed.

If the unit passes the previous tests, and records and plays satisfactorily, it can be considered operational. If not, proceed with the following tests and adjustments.

POWER SUPPLY VOLTAGES

The power supply should be checked for presence of its voltages before any other checks or adjustments are made. The power supply voltages should be as follows:

1. +12V, regulated to within .2V. Ripple should be less than 100 MV P-P.
2. −12V, regulated to within .2V. Ripple should be less than 100 MV P-P.

NOTE

Do not adjust the +12V or −12V supplies if voltages are near their respective values as it will necessitate readjustment of servo and demod.

POWER SUPPLY ADJUSTMENTS

1. Connect the positive lead of the voltmeter to TP208 and the negative lead to the chassis.

NOTE

If the circuit board does not contain test points, use the left side of R209 for +12V test and the right side of R271 for the negative.

2. Measure the positive output. Adjust R479 for a +12.0V indication.

3. Place the unit in the RECORD mode, the +12V output should not vary more than .02V. Remove the positive lead from TP208.

NOTE

When adjusted, R479 and R426 should be in an approximate center position. If not, remove power from the unit and check for shorts or other circuit defects (blown fuse, bad transistor etc.) When circuit defect has been corrected repeat steps 1-3.

4. Turn function selector of the meter to indicate negative reading.

5. Connect meter lead to TP207.

6. Measure negative output. Adjust R426 for a −12.0V indication. Reading must not vary more than .02V from PLAY to RECORD. After the −12V output has been adjusted, recheck the +12V output and readjust if necessary.

SERVO ADJUSTMENTS

The recorder must be in sync before making any servo adjustments. If it is not, adjust the following controls to a center position: R225, R235, R258, and R275; adjust R210 full right.

1. Place the power ON-OFF control to ON (make sure unit is in PLAY mode). Connect oscilloscope probe to test point TP203 and the ground lead to the recorder chassis. Set the TRIGGERING MODE of the scope to LINE SYNC. While observing the square wave pattern (Some waveforms will have a rounded leading edge), adjust R225 until pattern (waveform) in Figure 6-1 is stopped or drifting slowly. Square wave should be 16.6 ms in length as shown.

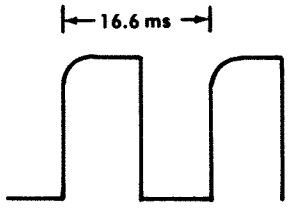


Figure 6-1. Square Wave Signal

2. Set the RECORD-PLAY lever to RECORD. Set the TRIGGERING MODE of the oscilloscope to INT and connect the probe of the oscilloscope to TP201. Check the TAC pulse, Figure 6-2. It should be 1.5V to 1.8V negative. If the voltage is larger, adjust the pole piece by moving the arm to the left or to the right of the center tab located on the bracket below the rotating disc. Moving the pole piece to the right or left reduces the pulse amplitude.

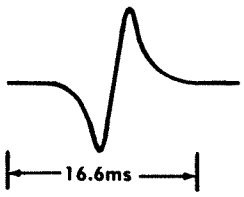


Figure 6-2. Tac Pulse

WARNING

Keep screwdriver and hands away from moving fan blade. The blade of the motor fan is turning and can cause bodily injury or damage to tools if brought too close.

3. Leave the recorder in RECORD-STBY and connect the probe of the oscilloscope to TP202. Rotate control R210 fully clockwise and then turn it counterclockwise until a positive pulse of 0.2V to 0.3V (see Figure 6-3) is observed on the screen of the oscilloscope.

Figure 6-3. Positive Pulse

4. Leave the recorder in RECORD-STBY and connect the probe to TP204 (leave sync in INT position). Adjust horizontal TIME and VARIABLE controls on the oscilloscope until the distance between the leading edge of the first positive pulse and the training edge of the negative pulse is 10 divisions (100%) of the horizontal deflection. Adjust R258 for a 53% positive pulse period and a 47% negative pulse period (Figure 6-4). Move RECORD-PLAY lever to PLAY and recheck the waveform to make sure that it remains the same.

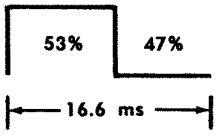


Figure 6-4

5. Place the recorder in PLAY-STBY and connect the VTVM probe to TP205. Stop the rotation of the head drum by hand for 10 seconds. Release the drum and wait 60 seconds; then adjust R275 for a 2.5V DC reading. Repeat step 5.

CAUTION

The torque of the drum motor is substantial, and will not stall in any normal operating mode. In fact, if power is turned off while the tape is moving, and the drum allowed to come to a halt, it will be found that the drum will reliably start and come up to synchronous speed even if the power on switch and play button are actuated simultaneously.

The only condition that will likely stall the drum, results if the recorder is threaded with power off and "thread/ready" knob is placed in the ready position without first turning on power and allowing the drum to come up to speed. Under these circumstances, the tape will likely cinch around the drum as the "thread/ready" knob is actuated and thus prevent the drum from rotating when power is turned off.

The recorder may be threaded with either power on, or off, however, it is strongly urged that power be turned on and time allowed for the drum to come up to speed before the "thread/ready" knob is activated. In this manner, the one condition that will stall the drum is avoided.

BIAS OSCILLATOR ADJUSTMENTS

1. Connect the low capacity probe of the oscilloscope to TP101.

2. Move the RECORD-PLAY lever to RECORD and depress the record pushbutton.

3. Turn AUDIO and VIDEO RECORD LEVEL controls fully counterclockwise.

4. Adjust T201 for a frequency of 67 KHz (15 per cycle). Then adjust C231 for 60 volts p/p indication on oscilloscope.

5. Connect scope to TP102 (Bias Trap Output) on the audio board. Adjust C116 (Bias Trap) for a minimum p-p signal.

AUDIO RECORD GAIN

1. Connect an AC voltmeter across the AUDIO OUT connector.

2. Connect a 1 KHz signal source (signal generator) to the rear panel AUDIO IN connector and place the audio selector to LINE position.

3. Set the signal generator for a 0.7v rms output, at a frequency of 1 KHz.

4. Set the RECORD-PLAY lever to RECORD and adjust the AUDIO RECORD LEVEL control for a 1.0v (rms) meter reading at the audio output.

5. Check the RECORD LEVEL meter, it should indicate approximately 100%. If not, adjust R121 (meter cal on the audio board) until the meter reads 100%.

VIDEO ADJUSTMENTS

Before making any video adjustments, make sure that the video head has been tested and is found to be good. If the video head has been replaced it must be contoured and adjusted before making any video adjustments. In addition, if the Mod-Demod board has been replaced, it is necessary to reset the positive and negative 12v regulators and the servo must be realigned before making the following video adjustments.

VCO CARRIERS AND DEMOD BALANCE

1. Connect the probe of the scope to TP402 (video output on Mod-Demod).

2. Connect a multiburst signal to the VIDEO IN connector.

3. Adjust the VIDEO RECORD LEVEL to 100%.

4. Connect a 3.5 MHz signal to TP401.

5. Adjust R408 (sync freq) for a zero beat at sync tip.

6. Change the generator frequency that is fed to TP401 to 5.5 MHz.

7. Adjust the video record level pot for zero beat at peak white.

8. Adjust R415 (PW Freq) for a video record indication 1/2 way into the red zone for the meter (120%). Remove generator.

9. Adjust R448 and C430 for minimum noise on the back porch of the blanking pedestal.

WOW AND FLUTTER CHECK

1. Connect jumper wire from the top ot R221 (1.5K), on the servo, to chassis.

2. Connect Wow and Flutter meter and Frequency Counter to the AUDIO OUT receptacle on the rear panel of the recorder (Ampex P/N 7960008-01); place unit in PLAY mode. Set TENSION control to center.

3. Set Wow and Flutter meter scale switch to LEVEL and adjust SET LEVEL control for a mid-scale reading. Turn Wow and Flutter meter scale switch to DISCRIMINATOR. Adjust for 0 meter reading with DISCRIMINATOR CENTERING control.

4. Set Wow and Flutter meter scale switch to 0.5%; with function switch set to WOW, reading should be 0.04% or less.

5. Set Wow and Flutter function switch to 0.5-250 Hz position, reading should be 0.3% or less.

6. Turn the TENSION control on the recorder fully clockwise; counter should give 2970 to 3030 Hz reading.

7. Turn TENSION control fully counterclockwise. Counter should read 2970 to 3030 Hz and should be within 10 Hz of the reading in step 6.

8. If Wow and Flutter is normal rewind and remove the tape. Also remove the jumper wire. If the recorder does not pass this test, refer to capstan drive adjustment.

VIDEO HEAD OPTIMIZATION AND DRIVE BALANCE

1. Thread a blank tape on the recorder.

2. Connect a microphone to the AUDIO IN connector on the rear panel.

3. Place the unit in the RECORD mode.

4. Adjust the AUDIO LEVEL control for 100% reading on the AUDIO LEVEL meter while speaking into the microphone.

5. Adjust the VIDEO LEVEL control fully counterclockwise.

6. Connect the probe of the oscilloscope to TP302 and adjust R301 (head drive) for a 15v P-P reading.

7. Set scope time base to 2 ms position.

8. Observe the RF envelope and the dark area in the center of the envelope. Adjust R423 so that the portion above and below the dark area are equal.

9. Depress the RECORD button and increase R301 (head drive) for a 30v reading (in two volt increments) while announcing the voltages into the microphone.

10. Rewind the tape; connect the scope to TP 401 and play the tape while observing the signal. As the voltage increases and then decreases, note the point where the peak-to-peak value is the highest.

11. Reconnect the scope to TP302 and adjust R301 for the scope indication as (highest value) in step 10.

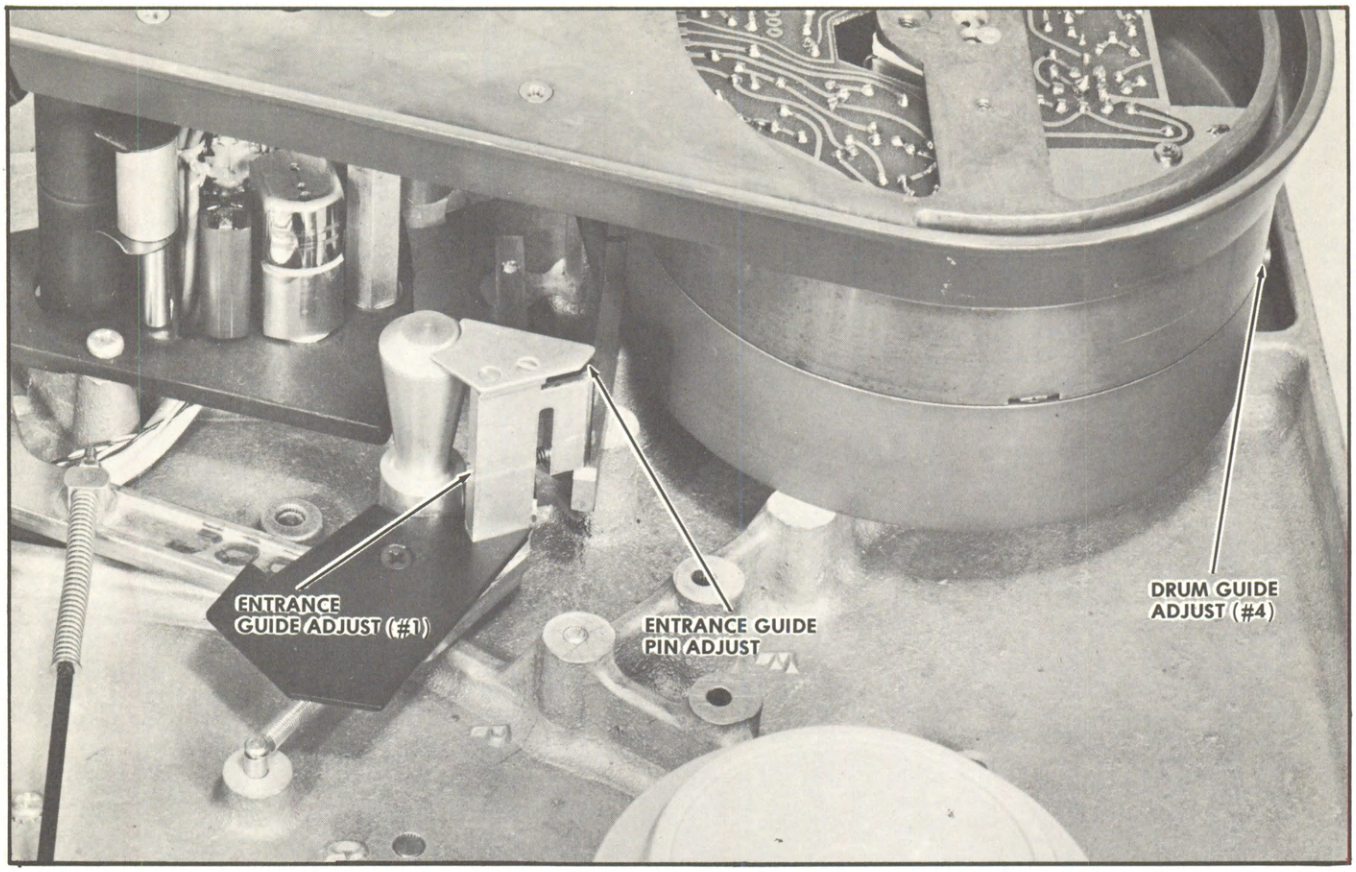


Figure 6-5. Exit and Video Rise Guide Adjustments

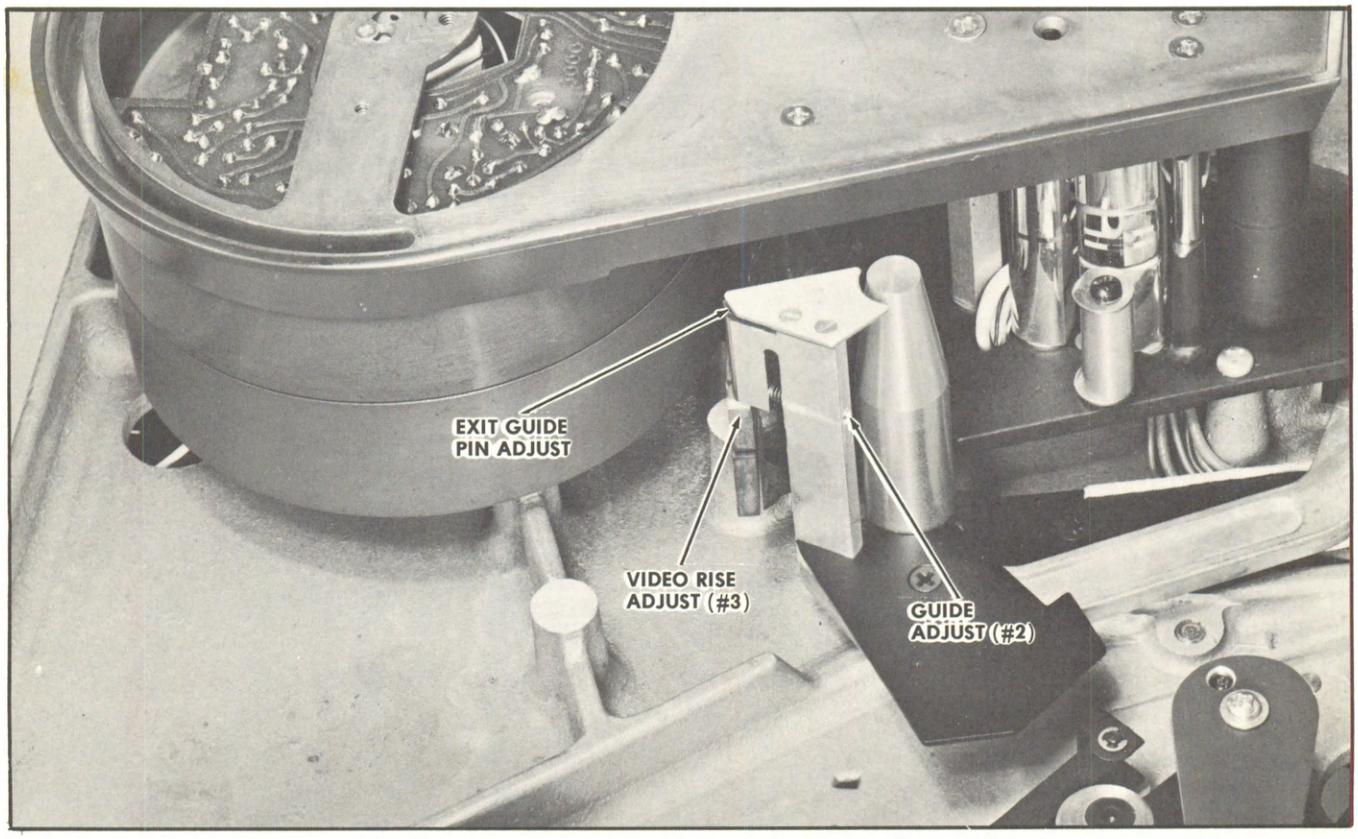


Figure 6-6. Entrance and Drum Guide Adjustments

INTERCHANGE ADJUSTMENTS

GENERAL INFORMATION

The tape path components of the recorder must be adjusted (interchange adjustments) to ensure playback of the master tape without cross tracking. A TV monitor can be used as a sensitive indicator of cross tracking. To be able to play the master tape without cross tracking is not proof that the interchange adjustments are correct. However, the interchange adjustments should not be performed unless the recorder is operating properly. If in doubt, first check operation, then check quality of interchange as described in the following paragraphs.

EQUIPMENT REQUIRED

The following equipment is required to perform interchange adjustments:

1. Master Interchange Tape
2. Oscilloscope
3. .072 in Bristol wrench
4. Small blade screw driver
5. TV Monitor

CHECKING INTERCHANGE QUALITY

The video record format of the VR5000 consists of a series of .006" recorded tracks with a center to center distance of .0087". When viewed on a TV monitor, playback is not seriously affected by tracking variations until the head picks up some portion of the adjacent recorded track. As a result, when the tape path is the same for both playback and record (the situation that exists when a recorder plays back a tape that it recorded), the timing between the video head position and the control track pulses can be varied ±6 milliseconds from optimum without seriously affecting the picture. The measure of interchange quality is determined by the degree of variation that is possible between the video head position and the control track without affecting the picture. The interchange adjustments are satisfactory if a 10 millisecond variation (±5 milliseconds from optimum) can be obtained.

The timing between the control track pulses and the video head position is adjustable by the "Tracking Control". Timing variation can be determined by externally triggering the oscilloscope with the control track pulses from TP206, and measuring the horizontal displacement of the scope trace as the tracking control is varied.

When playing the tape, the optimum position for the tracking control may not be at mid-range for some recorders. This condition is normal but will not allow the 10 millisecond noise-free picture. In this case a noise-free picture can be obtained at two different tracking positions. If the spacing between the two noise-free areas does not exceed 7 milliseconds the interchange adjustments are satisfactory.

The interchange procedure is divided into the following steps:

1. Adjustment of the entrance and exit guide pin angles to obtain a reasonably flat RF envelope with no more than one tracking cross over (adjustments 1 and 2).
2. Setting video rise (adjustment 3).
3. Adjustment of entrance and exit guide pin angles to obtain an RF envelope as shown in Figure 6-9 (adjustments 1 and 2).
4. Adjusting the tape guide on the back of the drum to obtain a flat envelope as shown in Figure 6-10 (adjustment 4).
5. Rechecking adjustments in steps 1 and 2.

DETAILED PROCEDURES:

1. Connect the vertical input of the oscilloscope, through a 10:1 divider probe to TP401. Monitor the RF playback envelope and adjust the tracking control for maximum amplitude at the leading and trailing edges.

Perform guide adjustments 1 and 2. Figures 6-5 and 6-6 to eliminate tracking crossovers from the RF envelope as shown in Figure 6-11a and b. If the amplitude fluctuation are most severe at the leading edge, as shown in Figure 6-11c, start adjustment with screw #2, Figure 6-6. To determine which way to turn the adjustment screw, apply an outward force on the top of the guide. If this improves the RF envelope (reduces the severity of its amplitude fluctuations), the adjustment screw should be tightened (rotated clockwise). If applying an outward force on the top of the tape guide increases the severity of amplitude fluctuations, the adjustment screw should be loosened.

After the first adjustment is optimized, proceed to the other guide adjustment. Again apply an outward force to the top of the guide to determine which way to turn the adjustment screw. After the second adjustment is made, it may be necessary to touch up the first adjustment because these adjustments interact.

2. Obtain RF envelope with no more than one tracking crossover; and optimize the video rise adjustment. Adjust the tracking control to peak the trailing edge of the RF envelope. Readjust the video rise (adjustment 3 in Figure 6-6) to peak the leading edge of the envelope. If adjustment is correct, the leading and trailing edges of the RF envelope will rise and fall together, reaching minimum amplitudes simultaneously as the tracking control is varied. If not, adjust the trailing edge of the envelope for a minimum amplitude with the tracking control, then, readjust the video rise until the leading edge is at a corresponding amplitude.

NOTE

Proper adjustment is more readily determined at the minimum RF output position of the tracking control. Inaccurate results are obtained if the video rise isn't near optimum before performing the two step procedure.

3. The dip in the middle of the envelope results when the tape tracking is low at the rear of the drum. This condition is necessary so the tape will be biased down on the rear drum guide (adjustment 4 in Figure 6-5) when the latter is brought up to the optimum position. Peak the leading and trailing edges of the RF envelope with the tracking control. With adjustments 1 and 2, obtain a symmetrical dip in the envelope.

When the tracking control is adjusted to peak the leading and trailing edges of the envelope, the low point should have an amplitude that is not greater than 1/3 the level of the peak envelope amplitude and not less than that which will cause a tracking cross over. The dip is caused by low tape tracking at the rear of the drum. This condition is secured with adjustments 1 and 2 (clockwise rotation) from the positions that produce a flat RF envelope.

4. When the RF envelope (Figure 6-9) is obtained, the tape guide at the rear of the drum can be adjusted. Set the tracking control to peak the RF envelope at its leading and trailing edges; then, rotate the eccentric mounted rear guide with a screwdriver until the amplitude at the center of the envelope is at a peak. Reset the tracking control until the RF envelope amplitude is at or near minimum. The amplitude at the center of the envelope should be equal to that at the ends. If not, readjust rear drum guide for that result.

5. If there are dips in the envelope between the leading and trailing edges, the entrance and exit guide pin angles (adjustments 1 and 2) require further adjustment. When the flatest RF envelope is achieved, check the interchange quality as described.

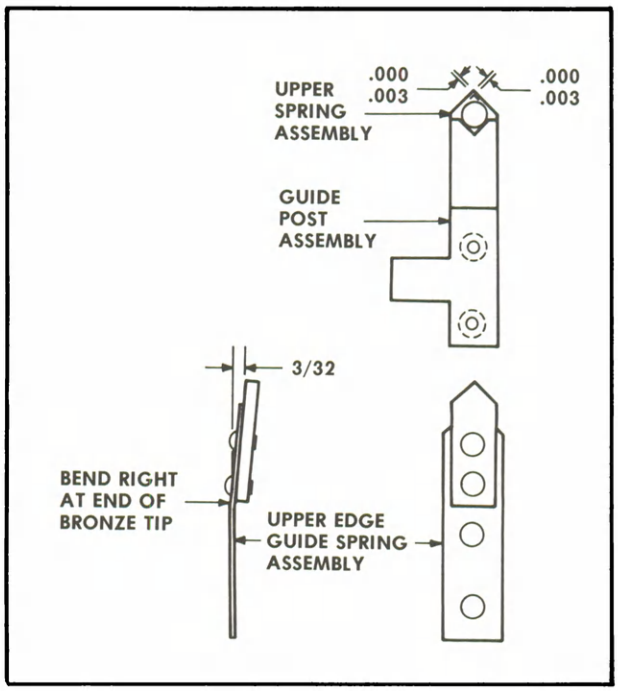


Figure 6-7. Edge Guide Adjustment

LOCKING THE INTERCHANGE SCREWS

After interchange quality has been checked and found to be satisfactory, the adjustment screws must be locked. For adjustments 1, 2 and 3, this is accomplished by placing a drop of grade epoxy on the set screw threads. The rear drum guide is locked by placing a drop of epoxy on the bottom of the guide. Be sure epoxy is not on top of the guide where the tape travels.

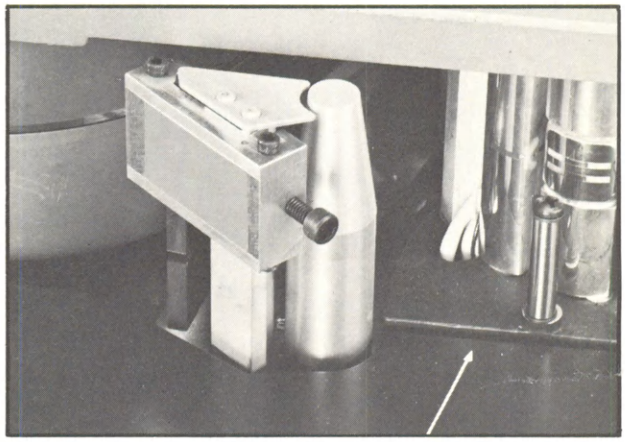


Figure 6-8. Edge Guide Alignment Tool in Position

INTERCHANGE TROUBLESHOOTING

Some of the interchange adjustment problems and their solutions are as follows:

1. Amplitude fluctuation of the RF envelope at its leading or trailing edge is usually due to a damaged or missing upper edge guide on the drum exit guide, excessive tightening of adjustments 1 or 2, or some defect in the tape path leading to, or leaving the drum.

If the fluctuation is at the leading edge of the RF envelope, check the adjustment of the upper edge guide on the left hand drum guide. An upper edge guide is not used on the right hand drum guide post. If left hand upper edge guide adjustment is correct, check tape path for loose heads, guides or misdressed wires.

The edge guide is spring loaded and the amount of spring preload should be between 8 and 15 grams to lift the edge guide off of the guide post. If spring preload is incorrect the edge guide must be removed and the spring reformed as shown in Figure 6-7. When the edge guide is replaced, it must be placed over the guide post pin as shown in Figure 6-7. If the sides of the edge guides overhand the guide post more than .003 inch, the edge guide may strike the drum. A tool, Ampex part no. 7036026-1N4, is available for positioning the upper edge guide. Refer to Figure 6-8 for correct use of the tool. When edge guide adjustment is known to be correct and fluctuation still occurs at the leading edge of the envelope, adjustment #2 is too tight. Correct by rotating adjustment screw #2 counter clockwise.

If fluctuations occur at the trailing edge of the envelope adjustment #1 is too tight. Correct by rotating adjustment screw #1 counter clockwise.

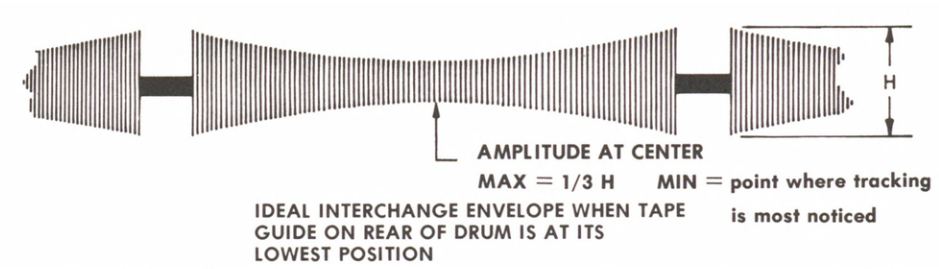
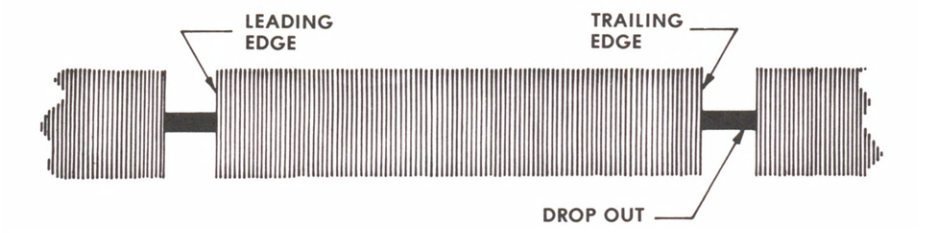


Figure 6-9 . Ideal Interchange RF Envelope Adjustment



IDEAL INTERCHANGE ENVELOPE

Figure 6-10. Ideal Interchange RF Envelope

RF PLAYBACK ENVELOPES

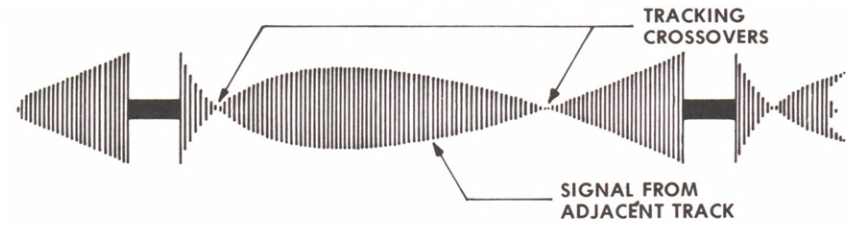


ILLUSTRATION A

ENVELOPE WITH MOST SEVERE AMPLITUDE FLUCTUATIONS NEAR LEADING EDGE

ILLUSTRATION B

ENVELOPE IMPROVED FROM THAT OF ILLUSTRATION C

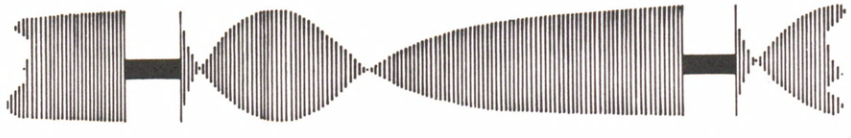


ILLUSTRATION C

ENVELOPE WITH GREATER GUIDING ERROR THAN THAT OF ILLUSTRATION A

Figure 6-11. RF Envelopes with Crossovers

2. Amplitude fluctuation of the RF envelope at or near its center. If there is too much downward bias of the tape on the guide at the rear of the drum the tape will occasionally buckle on the guide. If there is sufficient downward bias of the tape on this guide, the tape will occasionally lift off of the rear guide. There are two ways to determine which of these conditions is causing the problem. The first, simply observe the lower edge of the tape as it passes the rear guide and watch for buckling or occasional departure of the tape from the guide. Second, rotate the eccentric mounted rear drum guide to its lowest position; then, adjust the tracking control to peak the leading and trailing edges of the RF envelope. If there is cross tracking in the middle of the RF envelope, it is an indication that the down bias is too high. Conversely, if the dip in the middle of the RF is less than that shown in Figure 6-9, the down bias is insufficient. Down bias is increased by tightening adjustments 1 and 2 and is decreased by loosening adjustments 1 and 2.

3. Dips in the RF envelope that cannot be sufficiently reduced between the points of the entrance guide, the rear drum guide, and the exit guide are due to excessive departures of the drum surface. The possible causes for such departures include drum O.D. taper, excessive diameter difference in the upper and lower drums, and poor drum balance. If necessary, replace the drum assembly.

4. Dip in the RF Envelope just after its leading edge can result if the video head tip projection is excessive. This causes the tape to bounce away from the head, and the resulting dip will not be affected by the tracking control, but will be present when the tape is played. The leading 7% portion of the RF envelope, corresponding to the vertical blanking interval, may have a slightly different amplitude than the remainder of the envelope.

TRACKING CHANGES THAT OCCUR WHEN THE TAPE IS REWOUND OR WHEN THE THREAD/READY CONTROL IS OPERATED

This effect is due to improper entrance and exit guide arm seating, which in turn may be due to damaged or bent arms, or improper shimming of the arm stop conical washer. (Refer to Figure 6-12.)

To check arm seating, remove the video preamplifier casting assembly and the transport cover plate. Rotate the Thread/Ready control from the "Thread" position toward the "Ready" position just far enough to lightly seat the arms against the conical washer. (Do not rotate the control fully to the Ready locked position as it is not desired to fully seat the arms.) Under these conditions, check to see that the arms lay flat on the arm base rail.

Check the shimming of the arm stop conical washer. A .001 to .005 inch space must remain between the tape guide cones. The "Thread/Ready" control must be in the "Ready" position when this space is measured. Adding shims under the arm stop conical washer reduces the spacing between the cones at a rate of .002 reduction per .001 of shim added. The spacing between the tape guide cones can be checked by sliding shim stock between the cones.

After the arms are seated, check the "quality of interchange". When the proper interchange adjustments are obtained, check the tracking stability by making a recording and then checking the "good time" of the playback after the arms are opened and closed and the tape is stopped and started.

Eleven milliseconds (or more) "good time" should be achieved. If not, and a change in the appearance of the RF envelope is noted, the arm seating is not proper. If the procedure has been followed improper arm seating is produced because the arms are not laying flat on the arm base rail when the Thread/Ready control is in the mid position.

Failure to obtain eleven milliseconds of "good time" can also be caused by a fluctuating RF envelope as a result of improper interchange adjustments or poor tape.

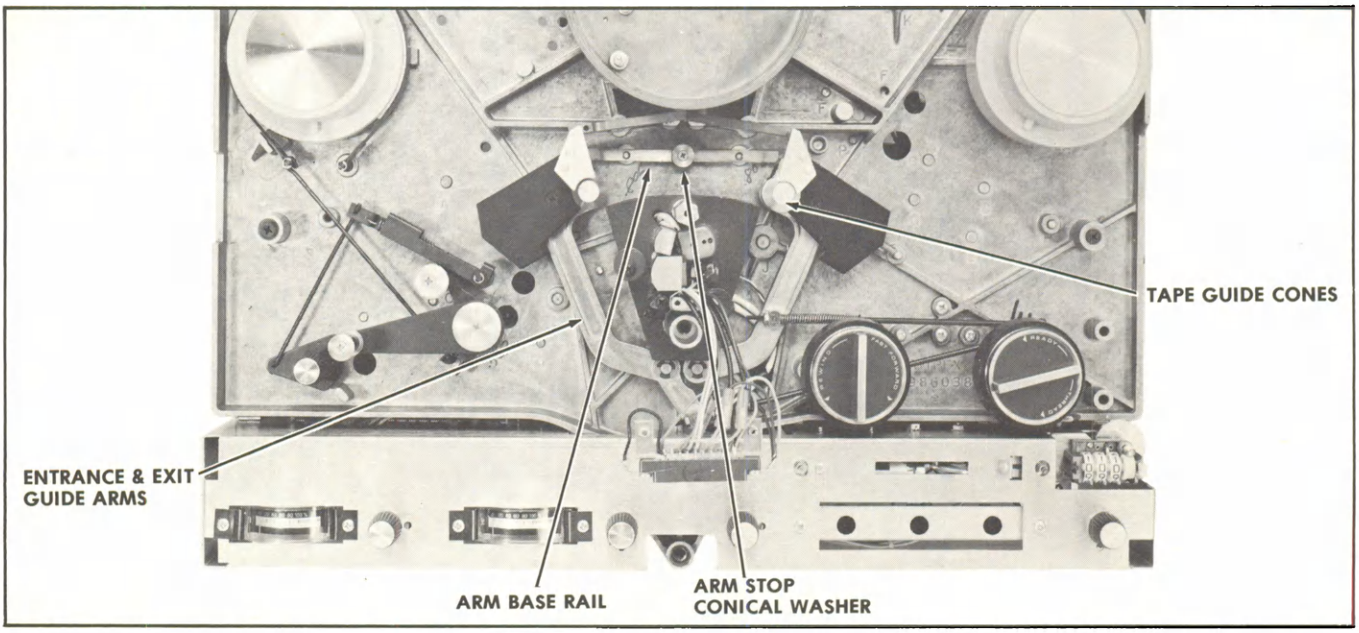
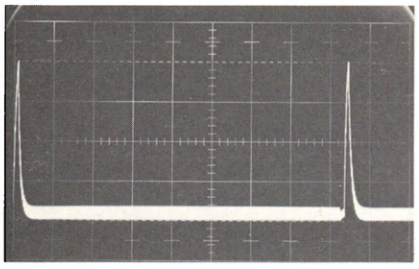


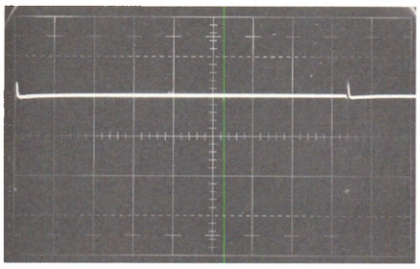
Figure 6-12. Top View of Transport with Cover Plate Removed, Entrance & Exit Guides in the "Thread" Position

WAVEFORM MEASUREMENTS

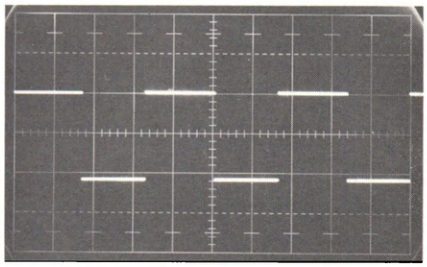
SERVO CIRCUIT BOARD



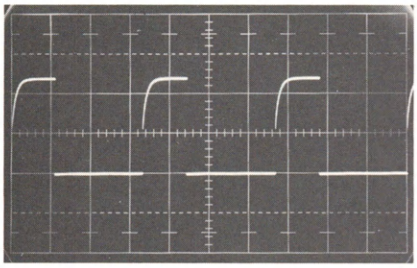
Q203 Emitter .2v/cm 2ms/cm



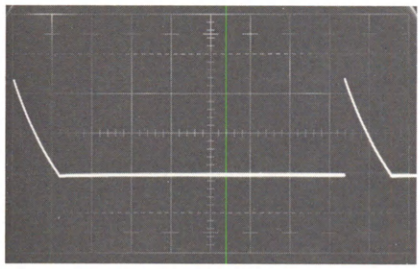
Q211 Collector .5v/cm 2ms/cm



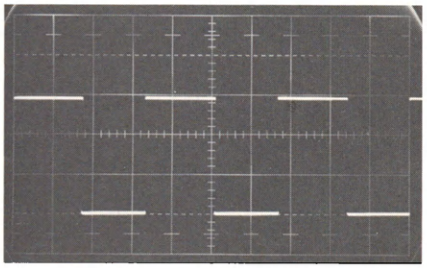
TP204 .5v/cm 5ms/cm



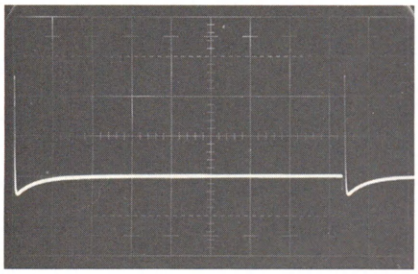
TP203 .5v/cm 5ms/cm



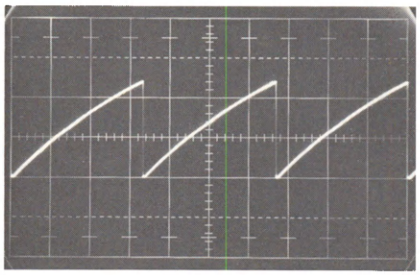
Q215 Base .5v/cm 2ms/cm



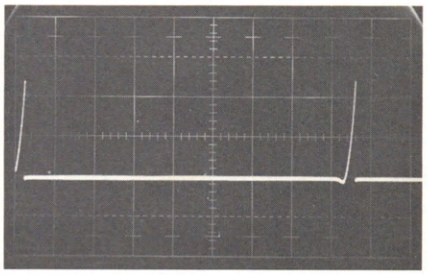
Q216 Base .05v/cm 5ms/cm



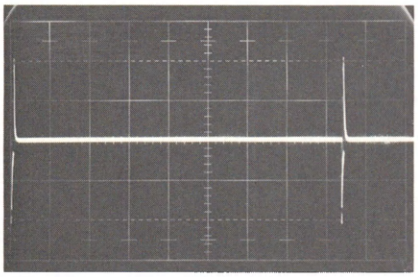
TP206 .05v/cm 2ms/cm



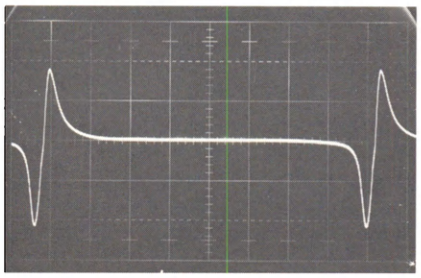
Q204 Collector .5v/cm 5ms/cm



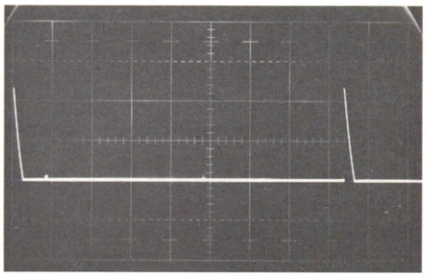
TP202 .01v/cm 2ms/cm



E204 .5v/cm 2ms/cm

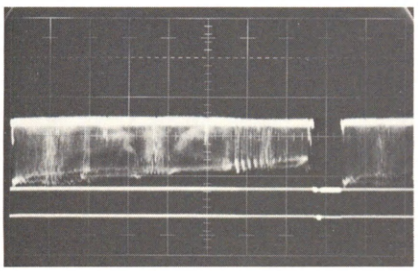


TP201 .1v/cm 2ms/cm

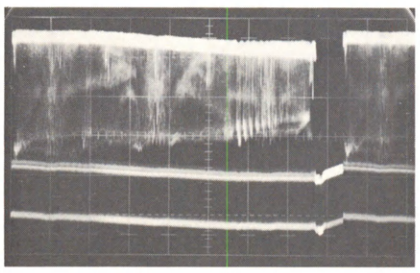


Q208 Base .5v/cm 2ms/cm

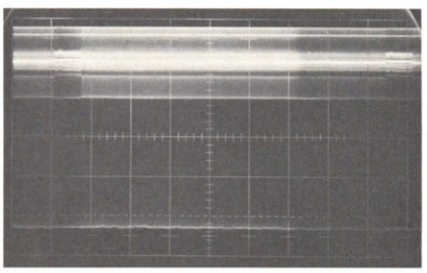
MOD.-DEMOD. CIRCUIT BOARD



TP403 .02v/cm 2ms/cm



TP402 .02v/cm 2ms/cm



CR409 Anode .2v/cm 2ms/cm

SERVICE PARTS

This section provides the technician with a complete disassembly of the Model VR5000 including parts lists and mechanical parts location information. It also provides instructions for using the electrical parts locating data as well as information for purchasing maintenance parts. PARTS LOCATING DATA — This information is organized according to circuit board layout, which may consist of one or more circuits. Parts mounted on the circuit boards are referenced on the boards. To obtain the part number, or characteristic of a part not on a circuit board, locate the drawing containing the part. Then view the illustration and identify the part and its reference designation. All detail parts shown on the schematic diagram can be identified on the parts list by the index number or reference designation that is printed adjacent to the circuit reference. The letters of a reference designation indicate the type of part or generic group. That is, C for capacitor, R for resistor, Q for transistor, etc. All capacitor values are listed in microfarads, resistance values are in ohms and inductance in henries unless otherwise specified.

A mechanical part depicted in the exploded views can be easily ordered or identified by noting the corresponding reference number that is printed next to the part. This number is listed in the mechanical parts list with the part number and description. If a part is needed for repairing the equipment, order as follows:

List the quantity, part number, part description, and model of recorder. Include part color, if applicable. Example: 1, no. 7046231, cover plate, transport, color — cordovan brown (metallic) for model VR5000. By using the description of a part, substitution of a part can be made when necessary.

MECHANICAL PARTS LIST

001	172-003	Lug, Ground #6
002	180-085	Terminal Strip, 5 Lug
003	180-563	Terminal Strip, 3 Lug
004	250-059	Bumper, Rubber
005	302-370	Clamp, Cable
006	302-385	Clamp, Cable
007	408-056	Pin, Steel 3/32" Dia. x 1/2" Lg.
008	430-067	Retaining Ring (1/8")
009	430-090	Retaining Ring (3/16")
010	430-091	Retaining Ring (5/16")
011	430-340	Retaining Ring (11/64")
012	430-381	Retaining Ring (1/4")
013	430-383	Tinnerman Compression Ring
014	470-053	Screw, #2-56 x 1/4" Hex Socket Hd.
015	470-428	Screw, #4-40 x 5/8" Bristol Socket Hd.
016	470-437	Screw, #4-40 x 5/16" Bristol Socket Hd.
017	471-062	Screw, #4-40 x 3/8" Pan Hd.
018	471-067	Screw, #6-32 x 1/4" Pan Hd.
019	471-069	Screw, #6-32 x 3/8" Pan Hd.
020	471-072	Screw, #6-32 x 5/8" Pan Hd.
021	471-073	Screw, #6-32 x 3/4" Pan Hd.
022	471-092	Screw, #10-32 x 7/8"
023	471-325	Screw, #4-40 x 3/16" Flat Hd.
024	471-326	Screw, #4-40 x 1/4" Flat Hd.
025	471-334	Screw, #6-32 x 1/4" Flat Hd.
026	471-336	Screw, #6-32 x 3/8" Flat Hd.
027	471-347	Screw, #8-32 x 1/2" Flat Hd.
028	471-352	Screw, #10-32 x 1/4" Flat Hd.
029	471-969	Screw, #2-56 x 3/16" Button Hd.
030	472-290	Screw, #4-40 x 1/4" Pan Hd.
031	472-420	Screw, #10-24 x 1" Pan Hd.
032	472-944	Screw, #6-32 x 1/4" Flat Hd.
033	473-044	Screw, #8-32 x 1/4" Flat Hd.
034	473-046	Screw, #8-32 x 3/8" Flat Hd.
035	473-050	Screw, #8-32 x 1/2" Pan Hd.
036	473-059	Screw, #8-32 x 1/2" Flat Hd.
037	473-109	Screw, #6-32 x 1-3/8" Pan Hd.
038	473-114	Screw, #6-32 x 2-1/2" Pan Hd.
039	473-154	Screw, #10-32 x 5/8" Fil. Hd.
040	475-068	Screw, #4-40 x 1/4" Pan Hd.
041	475-081	Screw, #6-32 x 1/4" Pan Hd.
042	475-092	Screw, #8-32 x 3/8" Pan Hd.
043	475-098	Screw, #6-32 x 1/2" Pan Hd.
043A	475-103	Screw, #4-40 x 1/2" Pan Hd.
044	475-104	Screw, #4-40 x 9/16" Pan Hd.
045	475-106	Screw, #6-32 x 1-3/8" Pan Hd.
046	475-108	Screw, #8-32 x 1/4" Pan Hd.
047	475-110	Screw, #8-32 x 7/16" Pan Hd.
048	475-111	Screw, #8-32 x 1-3/8" Pan Hd.
049	475-115	Screw, #6-32 x 3/8" Pan Hd.
050	475-118	Screw, #4-40 x 1/2" Slotted Hex Hd.
051	475-125	Screw, #8-32 x 1-1/8" Pan Hd.
052	475-998	Screw, #6-32 x 3/4" Pan Hd.
053	476-041	Screw, #6 x 1/4" Pan Hd.
054	476-318	Screw, #6-32 x 1/4" Pan Hd.
055	476-328	Screw, #6Z x 3/8" Flat Hd.
056	476-336	Screw, #8-32 x 1/4"
057	477-358	Screw, Set #6-32 x 1/8" Bristol Cup Pt.
058	477-359	Screw, Set #6-32 x 1/4"
059	477-360	Screw, Set #6-32 x 1/4" Bristol Cone Pt.
060	477-361	Screw, Set #4-40 x 3/16" Bristol Cup Pt.
061	477-378	Screw, Set #8-32 x 7/8"
062	477-382	Screw, Set #8-32 x 1/4"
063	477-383	Screw, Set #8-32 x 5/8"
064	477-384	Screw, Set #6-32 x 1/2" Bristol Flat Pt.
065	477-386	Screw, Set #6-32 x 1/2" Bristol Cup Pt.
066	480-083	Screw, #1/4-28 x 2-1/2" Flat Hd.
067	492-009	Nut, Hex #6-32
068	492-011	Nut, Hex #10-32
069	492-049	Nut, Hex #3/8-32
070	493-005	Nut, #4-40 Self Locking
071	493-008	Nut, Stop #10-32
071A	493-167	Nut, Hex #14-28

MECHANICAL PARTS LIST (CONTINUED)

072	493-169	Nut, Hex #4-40
073	496-004	Nut, Hex #4-40
074	496-005	Nut, #6-32
075	501-009	Washer, Flat #6
076	501-187	Washer, .143 ID x .267 OD x .016 Thk.
076A	501-230	Washer, Wave
077	502-103	Lockwasher, #4 Ext. Tooth
078	4255016-01	Fan, Motor Capstan
079	4445002-10	Washer, Tape Guide
080	4605002-10	Clamp, Capacitor
081	7036005-01	Retractable Arm Entrance Guide Assy. (Inc. all Components)
082	7036006-01	Retractable Arm Exit Guide Assy. (Inc. all Components)
083	7036012-01	Capstan
083A	7036013-01	Plate, Thread-Ready Knob Assy. (Inc. all Components)
084	7036014-01	Pulley Assy., Take-Up
085	7036015-01	Pulley Assy., Supply
086	7036016-01	Actuator Retractable Arm & Shaft
087	7036037-01	Video Head Mtg. Plate Assy. (Inc. all Components)
088	7036065-01	Retraction Link Assy., Motor Plate
089	7036067-01	Reel, Take-Up
090	7036113-01	Screen, Vent (w/Adhesive Backing)
091	7036155-01	Wheel, Brake
092	7036164-01	Tape Tension Arm Assy.
093	7046012-01	Gear, Holdback Tension Reset Assy.
094	7046014-01	F/Fwd Pulley Retract Lever Assy.
095	7046015-01	Release Pawl Assy.
096	7046016-01	Rewind Pulley Retract Lever Assy.
097	7046017-01	Tension Arm Retract Lever Assy.
098	7046019-01	Clutch Disc Assy. (Inc. all Components)
099	7046021-01	Function Knob Plate & Stud Assy.
100	7046022-01	Clutch Band Assy. (Inc. all Components)
101	7046024-01	Video Head Mtg. Plate
102	7046025-01	F/Fwd Pulley Retract Link & Brake Crank Assy.
103	7046045-02	Drum Shield (Inc. Felt)
104	7046049-01	Head Mtg. Base Assy. (Less all Components)
105	7046050-02	Drive Wheel Assy. (Inc. all Components)
106	7046051-01	F/Fwd Pulley Support Arm Assy.
107	7046052-01	Rewind Pulley Support Arm Assy.
108	7046053-02	Play Solenoid Assy. (Inc. all Components)
109	7046056-01	Entrance Guide Support & Pin Assy.
110	7046057-01	Exit Guide Support & Pin Assy.
111	7046058-01	Upper Edge Guide & Spring Assy.
112	7046073-01	Tape Tension Disengagement Arm Assy. (Inc. all Components)
113	7046078-01	Plate, Secondary Clutch Assy. (Inc. all Components)
114	7046107-01	Moment Arm, Bushing & Shaft Assy.
115	7046108-01	Arm Mtg. Bushing & Pin Assy.
116	7046114-01	Pulley, F/Fwd & Rewind
117	7046124-01	Holdback Tension Crank & Shaft Assy.
118	7046126-01	Plate, Capstan
119	7046137-01	Turntable Bushing, Pin & Shaft Assy.
119A	7046147-01	Head Base Assy. (Inc. all Components)
120	7046091-01	Bracket, Mtg. Capacitor
121	7046196-01	Bracket, Mtg. (Left Rear)
122	7046096-02	Bracket, Mtg. (Right Rear)
123	7046227-01	Back Plate Assy. (Inc. Brushes)
124	7046228-01	Tac Disc Assy. (Inc. Magnet)
125	7046229-01	Rotor Assy.
126	7046231-01	Top Plate Sub-Assy.
127	7046232-01	Control Panel
128	7046233-01	Knob (Mech.) F/Fwd-Rwd
129	7046234-01	Knob, (Mech.) Ready/Thread
130	7046237-01	Brake, Rewind
131	7046252-01	Spring, Ground
132	7046271-01	Wheel, Drive Capstan
132A	7046305-01	Enclosure & Insulator Assy.
133	7046912-30	Video Rec/Play Head
134	7056064-01	Slip Ring Assy.
135	7056082-02	Control Track Head & Cable Assy.
136	7056084-02	Video Erase Head & Cable Assy.
137	7056085-02	Audio Head & Cable Assy.
138	7056276-01	Brush Housing Assy. (Inc. Brushes)
139	7206002-01	Knob (Elect.)
140	7106010-01	End Cap
141	7116000-01	Pushbutton
142	7116004-01	Inlay (Record)
143	7116004-02	Inlay (Play)
144	7116004-03	Inlay (Stop)
145	7116005-01	Plate, Trim L.H.
146	7116005-02	Plate, Trim R.H.
147	7116010-01	Insert, Turntable
148	7126012-01	Handle
149	7126017-01	Latch, Cover
150	7136007-01	Foot
151	7146004-01	Counter
152	7206007-01	Sleeve, Locating
153	7206009-01	Bearing, Thrust
154	7206015-01	Ball, Thrust
155	7206037-01	Bearing, Thrust Ball (W/Washers)
156	7216001-01	Post, Guide
157	7216002-01	Stand Up, Cover
158	7216005-01	Cone, Entrance
159	7216006-01	Cone, Exit
160	7216008-01	Pivot, Control Rod
161	7216009-01	Control Rod, Entrance
162	7216011-01	Pin, Interlock
163	7216017-01	Control, Rod, Exit
164	7216023-01	Stud, Clutch Band
164A	7216024-01	Stud, Adjustment
165	7216047-01	Shaft
166	7216060-01	Spacer Guide
167	7216062-02	Guide, Tape Cover L.H.
168	7216066-01	Guide, Edge Lower Entrance
169	7216083-01	Guide, Rewind Edge
170	7216084-01	Guide, Rewind Entrance
171	7216091-01	Rod, Brake
172	7216102-01	Guide, Edge Lower Exit
172A	7216142-01	Shaft, Handle
173	7216149-01	Core, Coil
174	7216153-01	Guide, Tape Cover R.H.
175	7216165-01	Stud, Tape Roller
176	7216199-01	Stud
177	7226011-01	Bracket, Plunger Stop
178	7226026-01	Spacer, Wind Motor
179	7226069-01	Spacer, Motor Mtg.
180	7226077-01	Stop, Guide Arm
181	7226079-01	Support, Retract Arm Stop
182	7226090-01	Clamp, Handle Shaft
183	7226090-02	Clamp, Handle Shaft
184	7226909-01	Post, Dummy
185	7236005-01	Lever, Brake Crank
186	7236011-01	Rewind Pulley Retract Link Assy.
187	7236012-01	Tension Arm Retract Link Assy.
188	7236019-01	Link, Brake Release
189	7236028-01	Link, Motor Plate Retraction #2
190	7236029-01	Link, Motor Plate Retraction #1
191	7236031-01	Eccentric, Tape Tension Arm

MECHANICAL PARTS LIST (CONTINUED)

192	7236032-01	Arm, Tape Tension
193	7236036-01	Arm, L.H. Guide Pivot
194	7236037-01	Arm, R.H. Guide Pivot
195	7236049-01	Link, Retraction
196	7236050-01	Arm, Handle
197	7236050-02	Arm, Handle
198	7236070-01	Link, Spring Housing
199	7256016-01	Fan, Wind Motor
200	7256027-01	Turntable, Supply Reel (Inc. Shaft)
201	7256028-01	Turntable, Take-up Reel
202	7256029-01	Driver, Capstan
203	7256061-01	Roller, Tape
204	7266010-01	Support, Capstan Thrust
205	7266013-01	Bracket, Switch Interlock
206	7266014-01	Bracket, Brake Release
207	7266099-01	Bracket, Rear Panel Mtg.
208	7266119-01	Clip, Handle Retaining
209	7266130-01	Bracket, Mtg. Capacitor
210	7266162-01	Bracket, Rear Panel Mtg.
211	7266164-01	Pole Piece
212	7266165-01	Bracket, Coil Mtg.
213	7276004-01	Spring, Head Torsion
214	7276005-01	Spring, Thread Arm Return
215	7276006-03	Spring, Holdback Brake Ref.
216	7276008-01	Spring, Bell Crank
217	7276010-01	Spring, Pulley Loading
218	7276013-01	Spring, Right Thread Control Arm
219	7276015-01	Spring, Secondary Plunger
220	7276017-01	Spring, Tension Reset Clutch
221	7276018-01	Spring, Eccentric Loading
222	7276019-01	Spring, Stop-Play
223	7276020-01	Spring, Record
224	7276024-01	Spring, Solenoid Plunger
225	7276028-01	Spring, Left Thread Control Arm
226	7276031-01	Spring, Clutch
227	7276033-01	Spring, Hold Down
228	7276043-01	Spring, Turntable
229	7276052-01	Spring, Latch
230	7296007-03	Drum & Head Cover Casting (Less all Components)
231	7296008-01	Housing, Spring
232	7296011-01	Cover Insert, Drum & Head
233	7296044-01	Cover, Tape Tension Arm
234	7296114-01	Enclosure, Cover
235	7306000-01	Rivet, Split
236	7316001-01	Belt, Rewind & F/Fwd
237	7316003-01	Belt, Counter
238	7326002-01	Washer, Key
239	7336006-01	Plate, Thread-Ready Knob
240	7336007-01	Plate, Clutch Tension Adjust
241	7336012-01	Plate, Mtg. Wind Motor
242	7336045-01	End Frame, Portable Case
243	7336049-01	End Frame, Cover
244	7336051-01	Cabinet Rail, Front
245	7336052-01	Cabinet Rail, Rear
246	7336073-01	Plate, Front P.C. Motor
247	7356002-01	Brushes (6 Req.)
248	7406002-01	Screw, Plunger Adjustment
249	7406003-01	Screw, Drum
250	7406004-01	Screw, Video Head Mtg.
251	7440027-01	Washer, Oil Stop
252	7440028-01	Washer, Thrust
253	7446002-01	Washer, Capstan
254	7446005-01	Washer, Solenoid Plunger
255	7446006-02	Washer, .130 ID x .015 Thk.
256	7446006-05	Washer, .130 ID x 1/32" Thk.
257	7446006-12	Washer, .190 ID x 3/8" OD x .015 Thk.
258	7446006-13	Washer
259	7446006-21	Washer
260	7446006-22	Washer
261	7446006-23	Washer
262	7446006-24	Washer
263	7446006-32	Washer
264	7446006-53	Washer, Flat
265	7446006-55	Washer (As Required)
266	7446011-01	Washer, Oil
267	7446012-01	Washer, Bearing Spacer
268	7446016-01	Washer, Edge Guide #2
269	7446017-01	Washer, Lower Edge Guide
270	7446018-01	Washer, Upper Edge Guide
271	7446021-01	Washer, Spacer Capstan
272	7446022-01	Washer, Slinger
273	7446026-01	Washer, .140 ID x 15/64 OD x .003 Thk.
274	7446032-01	Washer, Tape Guide
275	7446033-01	Washer, Brake Clutch
276	7446034-01	Shield, Hum
277	7546001-01	Capacitor, Motor, 3 mfd., 330Vac
278	7586088-01	Coil, Tac
279	7596003-01	Motor, Wind
280	7596015-01	Solenoid, Capstan Drive
281	7596027-01	Motor, Drive (Capstan)
282	7626000-01	Switch, Snap
283	7660000-31	Terminal Strip
284	7686001-01	Speaker
285	7856031-01	Upper & Lower Drum Less Video Head & Slip Ring Assy. (Use 7036145-01 for Upper & Lower Drum with Video Head & Slip Ring)

MISCELLANEOUS ITEMS NOT SHOWN ON EXPLODED VIEW

085-007	Holder, Fuse
471-060	Screw, 4-40 x 1/4
471-062	Screw, 4-40 x 3/8
471-063	Screw, 4-40 x 7/16, Pan Hd.
471-071	Screw, 6-32 x 1/2
471-083	Screw, 8-32 x 7/8
475-068	Screw, 4-40 x 1/4, Sems
475-115	Screw, 6-32 x 3/8, Sems
476-200	Screw, No. 6 x 3/16, Type Z
476-225	Screw, No. 6 x 3/16, Type Z
476-879	Screw, No. 8 x 3/8, Self-tap
476-999	Screw, No. 6 x 3/8, Type Z
492-006	Nut, 4-40
492-009	Nut, 6-32
492-457	Nut, 3/8-32
493-005	Nut, 4-40, Self-locking
496-001	Nut, 8-32, Keps
496-004	Nut, 4-40, Sems
496-005	Nut, 6-32, Keps
497-186	Nut, Speed, 3-48
7036184-01	Link Assembly
7056187-01	Switch, Pushbutton Assembly
7146004-01	Counter
7206043-01	Sleeve
7206045-01	Spacer, Nylon
7276042-01	Spring
7276044-01	Spring-REC/PLAY return
7276071-01	Spring
7616000-01	Socker, Lamp

R. F. MODULATOR P. C. BOARD

7056164-03	Complete Assembly (A801)	7500008-10	P. C. Board less Components	
7056007-01	P. C. Board with Components			

CAPACITORS

C1	030-133	Ceramic, .001 mfd., 150V	C4	030-475	Ceramic, 3.3 pfd., 1KV
C2	030-040	Ceramic, 10 pfd.	C5	030-472	Ceramic, 1.5 pfd., 1KV
C3	030-133	Ceramic, .001 mfd., 150V	C6	030-473	Ceramic, 2.2 pfd., 1KV

DIODES

CR1	013-692	Germanium 1N60	CR2	013-692	Germanium 1N60

INDUCTORS

L1	7056009-10	R.F. Coil Sub-Assembly (inc. all Components)	L2	051-372	Choke, 4.7 uh.
			L3	051-372	Choke, 4.7 uh.
	7856004-01	R.F. Coil (less all Components)			

TRANSISTOR

Q1	014-682	2N3693

RESISTORS

R1	041-511	3.9K ohm, 1/4W., 5%	R5	041-428	470 ohm, 1/4W., 5%
R2	041-427	330 ohm, 1/4W., 5%	R6	041-419	100 ohm, 1/4W., 5%
R3	041-396	220 ohm, 1/4W., 5%	R7	041-419	100 ohm, 1/4W., 5%
R4	041-430	1.5K ohm, 1/4W., 5%	R8	041-419	100 ohm, 1/4W., 5%

AUDIO CIRCUIT BOARD

7056183-01	Circuit Board (Inc. all Components)	7506027-01	Circuit Board (Less all Components)

CAPACITORS

(All Capacitors ± 10% unless otherwise noted.)

C101	031-820	Electrolytic, 10 mfd., −0 +100%, 15V.	C111	031-198	Electrolytic, 1 mfd., −10 +75%, 25V.
C102	030-519	Ceramic, 47 pfd., 500V.	C112	030-625	Ceramic, .0022 mfd., 500V.
C103	031-820	Electrolytic, 10 mfd., −0 +100%, 15V.	C113	056-210	430 pfd., 5%, 500V.
C104	031-819	Electrolytic, 50 mfd., −0 +100%, 3V.	C114	055-175	Mylar, .001 mfd., 100V.
C105	031-820	Electrolytic, 10 mfd., −0 +100%, 15V.	C115	055-262	Mylar, .0015 mfd., 100V.
C106	031-820	Electrolytic, 10 mfd., −0 +100%, 15V.	C116	056-212	Variable, 110-450 pfd., 175V.
C107	030-519	Ceramic, 47 pfd., 500V.	C117	031-824	Electrolytic, 25 mfd., ± 100%, 15V.
C108	031-141	Electrolytic, 10 mfd., −10 +75%, 15V.	C118	030-519	Ceramic, 47 pfd., 500V.
C109	031-769	Electrolytic, 25 mfd., −10 +75%, 15V.	C119	030-626	Ceramic, .01 mfd., 500V.
C110	031-819	Electrolytic, 50 mfd., −0 +100%, 3V.			

INDUCTORS

L101	051-604	18 mh.	L102	051-604	18 mh.

TRANSISTORS

Q101	7576015-04	Silicon, NPN, 0.5W.	Q104	7576015-01	Silicon, NPN, 0.5W.
Q102	7576015-04	Silicon, NPN, 0.5W.	Q105	7576015-01	Silicon, NPN, 0.5W.
Q103	7576015-01	Silicon, NPN, 0.5W.	Q106	7576015-01	Silicon, NPN, 0.5W.

AUDIO CIRCUIT BOARD (CONTINUED)

RESISTORS

(Note: All resistors 1/4W., 10% unless otherwise noted.)

R101	041-626	100K ohm	R114	049-333	100 ohm
R102	041-626	100K ohm	R115	049-388	1.5M ohm
R103	049-355	220K ohm	R116	041-633	10K ohm
R104	049-522	1.5K ohm	R117	041-630	22K ohm
R105	041-692	330 ohm	R118	049-371	33K ohm
R106	041-637	3.9K ohm	R119	049-523	18K ohm
R107	041-633	10K ohm	R120	041-639	2.2K ohm
R108	041-961	39K ohm	R121	058-192	Control, 2.5K ohm, ±30%, 1/4W.
R109	049-514	680K ohm	R122	041-630	22K ohm
R110	041-628	68K ohm	R123	041-637	3.9K ohm
R111	041-626	100K ohm	R124	041-979	1K ohm
R112	049-514	680K ohm	R125	041-633	10K ohm
R113	041-637	3.9K ohm			

S101	7626014-01	Two position, non shorting	S102	7626015-01	Two position, non shorting

MISCELLANEOUS ELECTRICAL HARDWARE

014-793	Pads, Transistor Mtg. (T018-case)	173-464	Terminal (E101, E102, E103)
173-532	Terminal (TP101, 102, 103)		

SERVO CIRCUIT BOARD

7056182-01	Circuit Board (Inc. all Components)	7506026-01	Circuit Board (Less all Components)

CAPACITORS

C201	031-822	Electrolytic, 1 mfd., 25V.	C218	037-452	Tant., 39 mfd., 6V., 20%
C202	055-178	Mylar, .01 mfd., 100V.	C219	055-219	Mylar, .22 mfd., 75V.
C203	055-185	Mylar, .47 mfd., 75V.	C220	055-179	Mylar, .022 mfd., 100V.
C204	055-178	Mylar, .01 mfd., 100V.	C221	055-219	Mylar, .22 mfd., 75V.
C205	055-182	Mylar, .1 mfd., 100V.	C222	055-179	Mylar, .022 mfd., 100V.
C206	055-219	Mylar, .22 mfd., 75V.	C223	055-219	Mylar, .22 mfd., 75V.
C207	031-818	Electrolytic, 25 mfd., 6V.	C224	055-264	Mylar, .39 mfd., 75V.
C208	055-175	Mylar, .001 mfd., 100V.	C225	031-820	Electrolytic, 10 mfd., 15V.
C209	055-180	Mylar, .047 mfd., 100V.	C226	031-141	Electrolytic, 10 mfd., 15V.
C210	055-180	Mylar, .047 mfd., 100V.	C227	056-141	Mylar, .0082 mfd., 100V.
C211	055-180	Mylar, .047 mfd., 100V.	C228	056-141	Mylar, .0082 mfd., 100V.
C212	030-627	Ceramic, .001 mfd., 500V.	C229	055-263	Mylar, .0062 mfd., 100V.
C213	055-219	Mylar, .22 mfd., 75V.	C230	055-182	Mylar, .1 mfd., 100V.
C214	030-627	Ceramic, .001 mfd., 500V.	C231	038-118	Mica, Var., 55-300 pfd., 175V.
C215	030-627	Ceramic, .001 mfd., 500V.	C232	055-182	Mylar, .1 mfd., 100V.
C216	055-182	Mylar, .1 mfd., 100V.	C233	031-824	Electrolytic, 25 mfd., 15V.
C217	037-452	Tant., 39 mfd., 6V., 20%			

DIODES

CR201	013-188	Germanium, 1N270	CR206	013-188	Germanium, 1N270
CR202	013-188	Germanium, 1N270	CR207	013-188	Germanium, 1N270
CR203	013-188	Germanium, 1N270	CR208	013-188	Germanium, 1N270
CR204A, B	013-839	Dual Silicon, MSD6150	CR209	013-752	Germanium, FD111
CR205	013-188	Germanium, 1N270	CR210	013-188	Germanium, 1N270

TRANSISTORS

Q201	7576015-03	Silicon, NPN, 0.5W.	Q208	014-882	NPS3638A
Q202	014-882	NPS3638A	Q209	014-882	NPS3638A
Q203	7576015-03	Silicon, NPN, 0.5W.	Q210	7576015-03	Silicon, NPN, 0.5W.
Q204	7576015-03	Silicon, NPN, 0.5W.	Q211	7576015-03	Silicon, NPN, 0.5W.
Q205	7576015-03	Silicon, NPN, 0.5W.	Q212	7576015-03	Silicon, NPN, 0.5W.
Q206	7576015-03	Silicon, NPN, 0.5W.	Q213	7576015-03	Silicon, NPN, 0.5W.
Q207	014-882	NPS3638A	Q214	014-882	NPS3638A

SERVO CIRCUIT BOARD (CONTINUED)

TRANSISTORS (CONTINUED)

Q215	014-882	NPS3638A	Q222	7570005-03	Silicon, NPN, 0.5W.
Q216	014-882	NPS3638A	Q223	7570005-03	Silicon, NPN, 0.5W.
Q217	014-882	NPS3638A	Q224	014-882	NPS3638A
Q218	014-882	NPS3638A	Q225	7576015-03	Silicon, NPN, 0.5W.
Q219	7576015-03	Silicon, NPN, 0.5W.	Q226	7570009-01	Silicon, NPN, 5W.
Q220	7576015-03	Silicon, NPN, 0.5W.	Q227	7570009-01	Silicon, NPN, 5W.
Q221	7570005-03	Silicon, NPN, 0.5W.			

RESISTORS

(Note: All resistors 10%, 1/4W. unless otherwise noted.)

R201	041-638	3.3K ohm	R245	049-371	33K ohm
R202	049-355	220K ohm	R246	049-356	470K ohm
R203	041-636	4.7K ohm	R247	041-638	3.3K ohm
R204	041-633	10K ohm	R248	041-633	10K ohm
R205	041-626	4.7K ohm	R249	041-635	6.8K ohm
R206	049-372	100K ohm	R250	049-522	1.5K ohm
R207	049-370	47K ohm	R251	049-531	750 ohm
R208	049-374	5.6K ohm	R252	041-642	330 ohm
R209	058-203	180K ohm	R253	049-372	47K ohm
R210	049-569	Control, 100K, 30%, 1/4W.	R254	041-628	68K ohm
R211	041-631	2.2M ohm	R255	049-365	150K ohm
R212	049-334	15K ohm	R256	041-633	10K ohm
R213	041-633	680 Ohm	R257	041-632	12K ohm
R214	041-636	10K ohm	R258	058-051	Control, 5K ohm, 30%, 1/4W.
R215	041-633	4.7K ohm	R259	049-570	1.8M ohm
R216	041-638	10K ohm	R260	041-629	27K ohm
R217	041-636	3.3K ohm	R261	049-514	680K ohm
R218	041-637	4.7K ohm	R262	049-374	180K ohm
R219	041-637	3.9K ohm	R263	041-762	360K ohm, 5%, 1/4W.
R220	041-637	3.9K ohm	R264	049-371	33K ohm
R221	041-979	3.9K ohm	R265	049-374	180K ohm
R222	049-520	1K ohm	R266	041-762	360K ohm, 5%, 1/4W.
R223	041-762	470 ohm	R267	049-371	33K ohm
R224	058-204	360K ohm, 5%, 1/4W.	R268	049-544	1.2M ohm
R225	041-633	Control, 250K, 30%, 1/4W.	R269	041-626	100K ohm
R226	041-633	10K ohm	R270	049-365	150K ohm
R228	041-633	10K ohm	R271	041-658	560 ohm
R229	041-633	10K ohm	R272	041-642	330 ohm
R230	049-540	390K ohm	R273	049-368	39 ohm
R231	049-372	47K ohm	R274	041-637	3.9K ohm
R232	049-540	390K ohm	R275	058-051	Control, 5K ohm, 30%, 1/4W.
R233	041-636	4.7K ohm	R276	049-369	1.2K ohm
R234	041-638	3.3K ohm	R277	041-630	22K ohm
R235	058-201	Control, 25K ohm, 30%, 1/4W.	R278	049-367	33 ohm
R237	049-524	270K ohm	R279	049-367	33 ohm
R238	041-625	120K ohm	R281	041-630	22K ohm
R239	041-633	10K ohm	R282	049-333	100 ohm
R240	041-636	4.7K ohm	R283	041-626	100K ohm
R241	041-633	10K ohm	R286	041-626	100K ohm
R242	049-356	470K ohm	R287	058-200	Control, 10K ohm
R243	049-371	33K ohm	R289	049-333	100 ohm
R244	041-638	3.3K ohm			

SWITCH

S201	7626016-01	

TRANSFORMER

T201	7586047-01	Bias osc.

MISCELLANEOUS HARDWARE

014-737	Heat Sink, Q225.	014-869	Pad, Transistor, Q202, Q210, Q224, Q227
014-769	Pad, Transistor, TO-5.	173-464	Terminal, male, E201-4
014-793	Pad, Transistor, TO-18.	173-532	Terminal, cambion TP201-8.

PREAMP CIRCUIT BOARD

	7056193-01	Circuit Board (Inc. all Components)		7506029-01	Circuit Board (Less all Components)

CAPACITORS

(All capacitors ±10% unless otherwise noted.)

C301	055-180	Mylar, .047 mfd., 100V.	C308	055-180	Mylar, .047 mfd., 100V.
C302	055-180	Mylar, .047 mfd., 100V.	C309	038-122	Variable, 7-60 pfd.
C303			C310	030-627	Ceramic, .001 mfd., 20%, 500V.
C304	055-180	Mylar, .047 mfd., 100V.	C311	055-180	Mylar, .047 mfd., 100V.
C305	030-627	Ceramic, .001 mfd., 20%, 500V.	C312	055-180	Mylar, .047 mfd., 100V.
C306	055-180	Mylar, .047 mfd., 100V.	C313	055-180	Mylar, .047 mfd., 100V.
C307			C314	055-180	Mylar, .047 mfd., 100V.

DIODES

CR301	7570215-11	Silicon, 400MW	CR302	013-752	Silicon, FD111

RELAY

K301	7596010-01	DPDT

INDUCTOR

L301	041-479	15 uh

TRANSISTORS

Q301	014-680	2N3642	Q305	014-682	2N3693
Q302	014-654	2N3646	Q306	014-682	2N3693
Q303	014-654	2N3646	Q307	014-682	2N3693
Q304	014-711	2N3638A	Q308	014-680	2N3642

RESISTORS

R301	058-058	Variable, 100 ohm	R315	041-629	27K ohm
R302	049-390	22 ohm	R316	049-333	100 ohm
R303	049-541	4.7 ohm	R317	049-008	47 ohm
R304	049-541	4.7 ohm	R318	049-005	2.7K ohm
R305	041-630	22 ohm	R319	058-061	Variable, 5K ohm
R306	049-513	68 ohm	R320	041-629	27K ohm
R307	041-630	22K ohm	R321	041-658	560 ohm
R308	041-630	22K ohm	R322	049-376	150 ohm
R309	049-539	27 ohm	R323	049-522	1.5K ohm
R310	049-522	1.5K ohm	R324	041-979	1K ohm
R311	049-539	27 ohm	R325	041-630	22 ohm
R312	049-005	2.7K ohm	R326	041-636	4.7K ohm
R313	049-333	100 ohm	R327	041-979	1K ohm
R314	049-334	680 ohm			

TRANSFORMERS

T301	7586011-01	Drive

MISCELLANEOUS ELECTRICAL HARDWARE

014-327	Heat Sink (Q301, Q308)	471-060	Screw, 4-40 x 1/4, PHMS
014-769	Pad, Transistor (Q301, 4, 8)	473-159	Screw, 4-40 x 5/8 PHMS (Nylon)
014-793	Pad, Transistor (Q302, 3, 5, 6, 7)	475-068	Screw, 4-40 x 1/4 with washer (Sems), PHMS
173-464	Terminal, male, E301, E302, E303		
175-532	Terminal (Cambion), TP301, TP302	496-004	Nut, 4-40 Keps

MOD.-DEMOD. BOARD

	7056184-01	Circuit Board (Inc. all Components)		7506028-01	Circuit Board (Less all Components)

MOD.-DEMOD. BOARD (CONTINUED)

CAPACITORS

(Note: All capacitors ±% unless otherwise noted.)

C401	031-819	Electrolytic, 50 mfd., 3V.	C428	030-685	Ceramic, 470 pfd., 500V.
C402	055-175	Mylar, .001 mfd., 100V.	C429	030-685	Ceramic, 470 pfd., 500V.
C403	031-818	Electrolytic, 25 mfd., 6V.	C430	038-226	Variable, Mica, 3 - 35 pfd., 175 - 350V.
C404	031-824	Electrolytic, 25 mfd., 15V.	C431	030-511	Ceramic, 10 pfd., 5%, 500V.
C405	031-818	Electrolytic, 25 mfd., 6V.	C432	030-511	Ceramic, 10 pfd., 5%, 500V.
C406	055-185	Mylar, .47 mfd., 75V.	C433	031-820	Electrolytic, 10 mfd., 15V.
C407	030-626	Ceramic, .01 mfd., −20 +80%, 500V.	C434	030-512	Ceramic, 12 pfd., 5%, 500V.
C408	030-626	Ceramic, .01 mfd., −20 +80%, 500V.	C435	030-512	Ceramic, 12 pfd., 5%, 500V.
C409	030-518	Ceramic, 47 pfd., 5%, 500V.	C436	056-209	Mica, 180 pfd., 5%, 500V.
C410	030-518	Ceramic, 47 pfd., 5%, 500V.	C437	030-624	Ceramic, 62 pfd., 5%, 500V.
C411	055-180	Mylar, .047 mfd., 100V.	C438	030-512	Ceramic, 12 pfd., 5%, 500V.
C412	055-180	Mylar, .047 mfd., 100V.	C439	031-824	Electrolytic, 25 mfd., 15V.
C413	055-180	Mylar, .047 mfd., 100V.	C440	055-182	Mylar, .1 mfd., 100V.
C414	055-180	Mylar, .047 mfd., 100V.	C441	030-566	Ceramic, 39 pfd., 5%, 500V.
C415	030-626	Ceramic, .01 mfd., −20 +80%, 500V.	C442	031-823	Electrolytic, 200 mfd., 10V.
C416	030-445	Ceramic, 470 pfd., 500V.	C443	031-818	Electrolytic, 25 mfd., 6V.
C417	030-626	Ceramic, .01 mfd., −20 +80%, 500V.	C444	030-561	Ceramic, 330 pfd., 1KV.
C418	030-626	Ceramic, .01 mfd., −20 +80%, 500V.	C445	030-625	Ceramic, .0022 mfd., 500V.
C419	030-302	Ceramic, 150 pfd., 500V.	C446	055-180	Mylar, .047 mfd., 100V.
C420	055-211	Mylar, .0047 mfd., 100V.	C447	030-626	Ceramic, .01 mfd., −20 +80%, 500V.
C421	Deleted		C448	031-818	Electrolytic, 25 mfd., 6V.
C422	030-626	Ceramic, .01 mfd., −10 +80%, 500V.	C449	030-626	Ceramic, .01 mfd., −20 +80%, 500V.
C423	055-211	Mylar, .0047 mfd., 100V.	C450	030-626	Ceramic, .01 mfd., −20 +80%, 500V.
C424	030-626	Ceramic, .01 mfd., −10 +80%, 500V.	C451	030-626	Ceramic, .01 mfd., −20 +80%, 500V.
C425	055-211	Mylar, .0047 mfd., 100V.	C452	030-626	Ceramic, .01 mfd., −20 +80%, 500V.
C426	030-506	Ceramic, 3 pfd., 5%, 500V.	C453	030-626	Ceramic, .01 mfd., −20 +80%, 500V.
C427	030-626	Ceramic, .01 mfd., −10 +80%, 500V.			

DIODES

CR401	013-752	Silicon, FD111	CR407	013-752	Silicon, FD111
CR402	013-188	Germanium, 1N270	CR408	013-752	Silicon, FD111
CR403	013-766	Zener, 9.1V., 10%	CR409	013-188	Germanium, 1N270
CR404	013-766	Zener, 9.1V., 10%	CR410	013-188	Germanium, 1N270
CR405	013-752	Silicon, FD111	CR411	013-188	Germanium, 1N270
CR406	013-752	Silicon, FD111			

INDUCTORS

L401	051-520	39 uh, 10%	L402	051-519	10 uh, 10%

TRANSISTORS

Q401	7576015-01	Silicon, NPN, 0.5W.	Q413	014-682	Silicon, NPN, 2N3693
Q402	7576015-01	Silicon, NPN, 0.5W.	Q414	014-682	Silicon, NPN, 2N3693
Q403	7576015-01	Silicon, NPN, 0.5W.	Q415	014-654	Silicon, NPN, 2N3646
Q404	7576015-01	Silicon, NPN, 0.5W.	Q416	014-654	Silicon, NPN, 2N3646
Q405	7576015-01	Silicon, NPN, 0.5W.	Q417	014-682	Silicon, NPN, 2N3693
Q406	014-654	Silicon, NPN, 2N3646	Q418	7576015-01	Silicon, NPN, 0.5W.
Q407	014-654	Silicon, NPN, 2N3646	Q419	014-882	Silicon, PNP, MPS3638A
Q408	014-882	Silicon, PNP, MPS3638A	Q420	014-882	Silicon, PNP, MPS3638A
Q409	014-882	Silicon, PNP, MPS3638A	Q421	7576015-01	Silicon, NPN, 0.5W.
Q410	014-867	Silicon, NPN, MPS3693-5	Q422	7576015-01	Silicon, NPN, 0.5W.
Q411	014-867	Silicon, NPN, MPS3693-5	Q423	014-682	Silicon, NPN, 2N3693
Q412	014-867	Silicon, NPN, MPS3693-5			

RESISTORS

(All resistors 1/4W., 10% unless otherwise noted.)

R401	049-395	180 ohm	R408	058-052	Control, 1K ohm, 30%, 1/4W.
R402	041-641	390 ohm	R409	041-626	100K ohm
R403	041-633	10K ohm	R410	041-633	10K ohm
R404	041-639	2.2K ohm	R411	049-388	1.5M ohm
R405	041-979	1K ohm	R412	041-641	390 ohm
R406	049-333	100 ohm	R413	041-639	2.2K ohm
R407	049-517	220 ohm	R414	041-639	2.2K ohm

MOD.-DEMOD. BOARD (CONTINUED)

RESISTORS (CONTINUED)

R415	058-051	Control, 5K ohm, 30%, 1/4W.	R448	058-053	Control, 500 ohm, 30%, 1/4W.
R416	049-520	470 ohm	R449	041-639	2.2K ohm
R417	049-520	470 ohm	R450	041-638	3.3K ohm
R418	049-545	120 ohm	R451	041-639	2.2K ohm
R419	058-053	Control, 500 ohm, 30%, 1/4W.	R452	041-044	470 ohm, 1/2W.
R420	041-637	3.9K ohm	R453	041-636	4.7K ohm
R421	049-520	470 ohm	R454	041-633	10K ohm
R422	049-520	470 ohm	R455	041-044	470 ohm, 1/2W.
R423	058-194	Control, 200 ohm, 30%, 1/4W.	R456	049-390	22 ohm
R424	041-642	330 ohm	R457	049-334	680 ohm
R425	041-637	3.9K ohm	R458	041-639	2.2K ohm
R426	058-053	Control, 500 ohm, 30%, 1/4W.	R459	049-334	680 ohm
R427	041-642	330 ohm	R460	049-333	100 ohm
R428	041-637	3.9K ohm	R461	041-636	4.7K ohm
R429	041-640	820 ohm	R462	049-522	1.5K ohm
R430	041-640	820 ohm	R463	058-192	Control, 2.5K ohm, 30%, 1/4 W.
R431	049-513	68 ohm	R464	049-008	47 ohm
R432	041-639	2.2K ohm	R465	041-636	4.7K ohm
R433	041-979	1K ohm	R466	041-639	2.2K ohm
R434	049-513	68 ohm	R467	041-642	330 ohm
R435	049-517	220 ohm	R468	049-513	62 ohm
R436	041-633	10K ohm	R469	049-371	33K ohm
R437	041-979	1K ohm	R470	041-639	2.2K ohm
R438	049-513	68 ohm	R471	041-640	820 ohm
R439	049-517	220 ohm	R472	041-638	3.3K ohm
R440	041-633	10K ohm	R473	041-630	22K ohm
R441	041-979	1K ohm	R474	041-639	2.2K ohm
R442	049-333	100 ohm	R475	058-192	Control, 2.5K ohm, 30%, 1/4W.
R443	049-517	220 ohm	R476	041-636	4.7K ohm
R444	041-639	2.2K ohm	R477	041-437	1.6K ohm
R445	041-979	1K ohm	R478	041-979	1K ohm, 5%
R446	041-048	1K ohm, 1/2W.	R479	058-053	Control, 500 ohm, 30%, 1/4W.
R447	041-642	330 ohm	R480	049-333	100 ohm

SWITCH

S401	7626017-01	Two position, non shorting

MISCELLANEOUS HARDWARE

	014-769	Pad, Transistor, Q408, Q409, Q419, Q420	014-793	Pad, Transistor, Q401-Q407, Q410, Q418, Q421, Q423
			173-532	Terminal (Cambion), TP401-TP403.

POWER SUPPLY ASSEMBLY

	7046142-01	With Components

CAPACITORS

C501	7556002-02	Electrolytic, 4000 mfd., 40V.	C503	7556008-01	Electrolytic, 2000 mfd., 15V.
C502	7556008-01	Electrolytic, 2000 mfd., 15V.			

DIODES

CR501	580-055	Silicon, 1.8a	CR503	013-875	Dual Diode, MR2361
CR502	580-055	Silicon, 1.8a	CR504	013-752	Silicon, FD111

FUSE

F501	070-010	1/16A, 3AG

JACKS

J501	169-436	Connector, 12 pin

POWER SUPPLY ASSEMBLY (CONTINUED)

TRANSISTORS

Q501	014-835	Silicon, MJE 370	Q503	014-814	Silicon, MJE 520
Q502	014-814	Silicon, MJE 520			

RESISTORS

R501	049-571	3 ohm, 1W., 5%	R503	041-637	3.9K ohm, 1/4W., 10%
R502	041-150	2.2K ohm, 1W., 10%			

MISCELLANEOUS HARDWARE

130-004	Fuse Holder	472-639	Screw
180-997	Terminal Strip	492-008	Nut, 4-40
471-062	Screw, 4-40 x 3/8	496-002	Nut

MOTOR CONTROL AMPLIFIER

7056514-01	Complete Assembly, with parts. (Does not include misc. hardware)

CAPACITORS

C604	7556002-02	Electrolytic, 4000 mfd., 40V.

DIODES

CR603	7570215-11	Silicon, 400 MW.

TRANSISTORS

Q601	014-814	Silicon, MJE 520	Q603	014-837	Silicon, PNP, Power MJ 2901
Q602	014-836	Silicon, NPN, Power MJ 2801			

RESISTORS

R605	041-343	680 ohm, 10%, 1/2W.	R607	041-194	100 ohm, 10%, 2W.
R606	041-091	4.7 ohm, 10%, 1W.			

MISCELLANEOUS HARDWARE

172-003	Lug, Solder, No. 6.	492-008	Nut, 4-40.
173-545	Lug, Solder, No. 4.	492-009	Nut, 6-32.
471-062	Screw, 4-40 x 3/8.	496-005	Nut, 6-32 (Keps).
471-071	Screw, 6-32 x 1/2.		

CHASSIS ELECTRICAL COMPONENTS (CONTINUED)

B701	7596027-01	Capstan Drive Motor	B703	See Exploded View	Drum Motor
B702	7596003-01	Wind Motor			

CAPACITORS

(All Capacitors ± 10% Unless Otherwise Noted.)

C601	055-180	Mylar, .047 mfd., 100V.	C702	7546001-01	Can-Type, 3 mfd., 300V, AC.
C602	030-795	Ceramic, .01 mfd., −20 + 80%, 500V.	C703	055-219	Mylar, .22 mfd., 75V.
C603	030-795	Ceramic, .01 mfd., −20 +80%, 500V.	C704	7540054-01	Ceramic, .005 mfd., +80 −20%, 1400V.
C701	7546001-01	Can-Type, 3 mfd., 300V, AC.	C705	7540054-01	Ceramic, .005 mfd., +80 −20%, 1400V.

DIODES

CR601	013-821	IN3491	CR702	7570215-11	Silicon, 400 MV.
CR602	013-821	IN3491	CR703	7571215-11	Silicon, 400 MV.

CHASSIS ELECTRICAL COMPONENTS (CONTINUED)

LAMPS

DS601	060-336	Incandescent, 27.5V.	DS602	060-001	Incandescent, 6.3V.

FUSE

F701	070-007	Cartridge, 3AG, Fast Blow, 5A, 250V.

JACKS

J601	143-236	Connector, 22 Pin.	J607	169-436	Connector, 12 Pin.
J602	146-449	Receptacle, 3 Socket.	J608	146-011	Connector, Jones, 18 Pin.
J603	143-236	Connector, 22 Pin.	J609	169-436	Connector, 12 Pin.
J604	143-236	Connector, 22 Pin.	J701	146-995	Connector, PC
J605	143-652	Jack, Pin-Type.	J702	145-435	Connector, 3 Pin (AC)
J606	143-238	Connector, 15 Pin.			

RELAYS

K601	7046139-01	Record-Hold Solenoid.	K701	7596015-01	Capstan-Drive Solenoid.
K602	7596014-01	Capstan-Hold Relay, 3 Pole.			

HEADS AND COILS

L701	7586088-01	Tac Coil.	L704	7056084-01	Head, Erase
L702	7056082-02	Head, Control Track.	L705	7046912-30	Head, Video
L703	7056085-01	Head, Audio			

METERS

M601	7056187-01	Video Record Level	M602	7056187-01	Audio Record Level

PLUGS

P601	7056333-01	Connector, 12 Pin (Power Supply)	P707	7056427-01	Connector, 12 Pin
P702	143-452	Connector, 3 Socket (RF Drive)	P709	7056425-01	Connector, 12 Pin (AMP)

RESISTORS

R601	7526001-01	Control, 100 ohm, Linear Taper.	R604	7526018-01	Control, 100K ohm, with AC Switch, (S601)
R602	7526012-01	Control, 25K ohm, Audio Taper.			
R603	7526011-01	Control, 100 K ohm, Linear Taper.	R701	7510063-01	1 ohm, 10%, 1/2W.

SWITCHES

S602	7626000-01	Snap-Type.	S701	7626000-01	Snap-Type.
S603	7626000-01	Snap-Type.	S702	7626000-01	Snap-Type.
S604	7626000-01	Snap-Type.			

SPEAKERS

SP601	7686001-01	7.2 ohm, Voice Coil.

TRANSFORMERS

T601	7586046-01	Power

MISC. CHASSIS HARDWARE

	085-007	Holder, Fuse	471-071	Screw, 6-32 x 1/2
	172-004	Lug, No. 4	471-083	Screw, 8-32 x 7/8
	471-060	Screw, 4-40 x 1/4, Pan Hd.	471-328	Screw, 4-40 x 3/8 Flat
	471-062	Screw, 4-40 x 3/8	471-448	Screw, #6-32 x 1-1/4"
	471-063	Screw, 4-40 x 7/16, Pan Hd.	472-854	Screw, 4-40 x 5/8
	471-066	Screw, 6-32 x 3/16, Pan Hd.	473-060	Screw, 3-48 x 1/2

CHASSIS ELECTRICAL COMPONENTS (CONTINUED)

MISCELLANEOUS CHASSIS HARDWARE (CONTINUED)

475-068	Screw, 4-40 x 1/4, Sems
475-085	Screw, 6-32 x 3/8, Pan Hd.
475-092	Screw, 8-32 x 3/8, Sems
475-115	Screw, 6-32 x 3/8, Sems
476-041	Screw, 6 x 1/4, Self-tap
476-200	Screw, No. 6 x 3/8, Type Z
476-225	Screw, No. 6 x 3/16, Type Z
476-340	Screw, 6 x 5/16, Type B
476-879	Screw, No. 8 x 3/8, Self-tap
476-998	Screw, 6 x 1/4, Type Z
476-999	Screw, No. 6 x 3/8, Type Z
492-006	Nut, 4-40
492-009	Nut, 6-32
492-050	Nut, 3/8-32
492-105	Nut, 10-32
492-457	Nut, 3/8-32
493-005	Nut, 4-40, Self-locking
496-001	Nut, 8-32, Keps
496-004	Nut, 4-40, Keps
496-005	Nut, 6-32, Keps
497-186	Nut, Speed, 3-48
498-278	Nut, 6-32 x 1/4
501-570	Shim, Round
502-015	Star washer, No. 8
502-077	Lockwasher, 3/8
7036078-01	Actuator, Assembly
7036184-01	Link Assembly
7056187-01	Switch Pushbutton Assembly
7136034-01	Grommet
7146004-01	Counter
7206043-01	Sleeve
7206045-01	Spacer, Nylon
7216115-01	Stud, Actuator support
7276042-01	Spring
7276044-01	Spring-REC/PLAY return
7276071-01	Spring
7616000-01	Socket, Lamp

REAR PANEL ELECTRICAL COMPONENTS

	7056194-01	Back Panel	A801	7056164-03	RF Modulator

CAPACITORS

C801	055-056	.1 mfd., 10%, 100V.

FUSE

F801	070-011	1/2A, SLO—BLO

JACKS

J801	146-998	Connector, 3 socket	J806	146-067	Connector, 1 socket
J802	147-999	Connector, 3 socket	J807	146-067	Connector, 1 socket
J803	146-009	Connector, 12 pin	P801	145-048	Connector, 18 pin
J804	7630041-01	Jack, phone-type, NC112A	P802	143-723	Connector, Pin-Type
J805	146-067	Connector, 1 socket			

RESISTORS

R801	041-979	1K	R802	049-372	47K

SWITCHES

S801	120-667	2P3T	S802	120-669	DPDT

MISCELLANEOUS REAR PANEL HARDWARE

085-007	Holder, Fuse
172-194	Lug, Solder
471-060	Screw, 4-40 x 1/4, Pan
471-328	Screw, 4-40 x 3/8, Flat
492-050	Nut, 3/8-32
492-105	Nut, 10-32, Small Pattern
496-004	Nut, 4-40, Keps
501-570	Shim, Round
502-077	Lockwasher, 3/8

MONITOR AMP CIRCUIT BOARD

7506076-01	Circuit Board (Less all Components)
7056316-01	Circuit Board (Inc. all Components)

CAPACITORS

C901	055-486	.015 mfd., 100V.	C903	031-869	Electrolytic, 500 mfd., −10 +100%, 15V.
C902	031-869	Electrolytic, 500 mfd., −10 +100%, 15V.			

TRANSISTORS

Q901	7576018-01	Silicon, NPN, 0.5W.	Q904	7576018-01	Silicon, NPN, 0.5W.
Q902	014-882	Silicon, NPN, MPS3638A.	Q905	014-814	NPN, MJE 520
Q903	014-882	Silicon, NPN, MPS3638A.	Q906	014-835	PNP, MJE 370

RESISTORS

(All resistors 1/4W., 10% unless otherwise noted.)

R901	041-979	1K ohm	R907	049-517	220 ohm
R902	041-632	12K ohm	R908	049-395	180 ohm
R903	049-355	220K ohm	R909	041-692	43 ohm, 5%
R904	041-639	2.2K ohm	R910	041-979	1K ohm
R905	041-639	2.2K ohm	R911	049-394	10 ohm
R906	041-638	3.3K ohm	R912	041-633	10K ohm

MISCELLANEOUS HARDWARE

014-793	Pad, Transistor Mounting.	496-004	Nut, 4-40 (Keps).
471-062	Screw, 4-40 x 3/8 PH.	7606004-01	Heat Sink.

MISCELLANEOUS ITEMS NOT SHOWN ON EXPLODED VIEW

000-009	White Tape	7736004-01	Cable, Power
102-055	Reel Assembly, Take-up	7886070-01	Carton, Recorder
169-355	Adapter, BNC to VHF	7886096-01	Carton, Outer
169-454	Adapter, AC (3 prong to 2 prong)	7886113-01	Corner, Ethaform
752-033	Tape, Test	7886114-01	Corner, Ethaform
7036124-01	Dust Cover	7886116-01	Carton, Tape & Reel
7176097-01	Sheet, Operating Instructions	7896072-01	Operators Manual

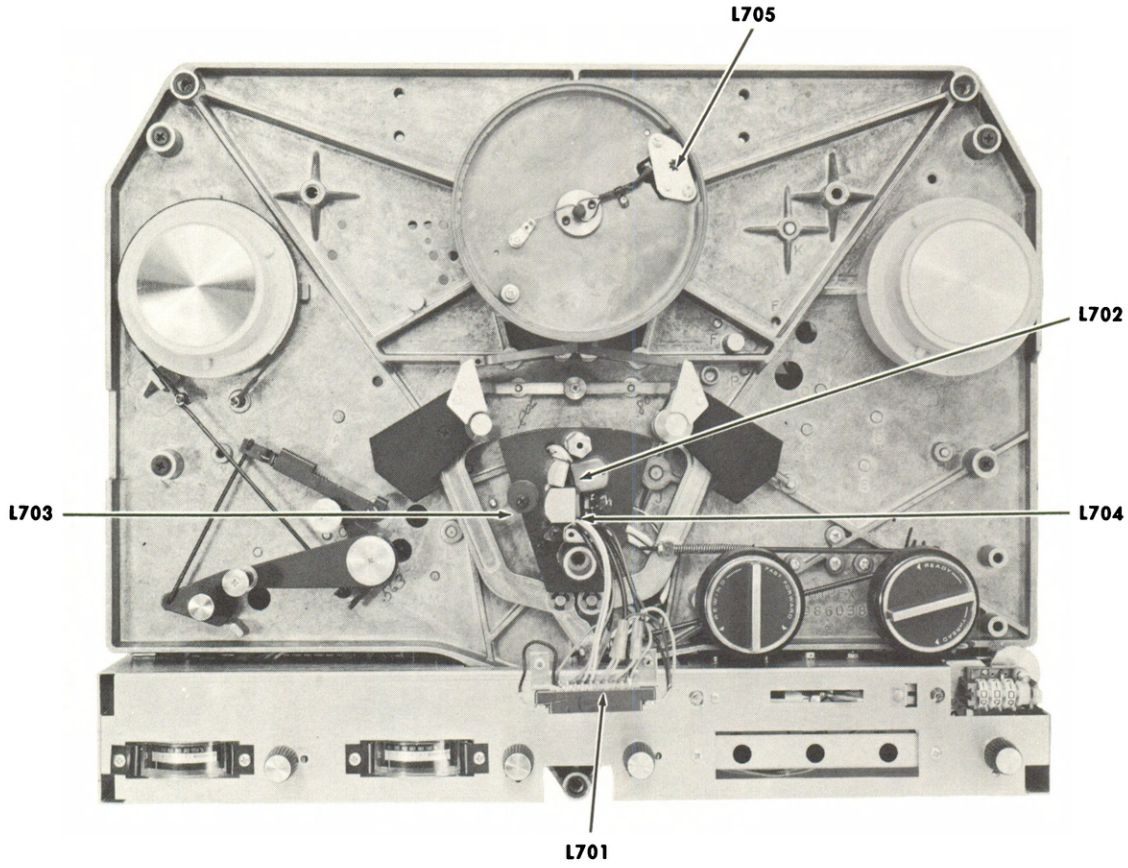


Figure 7-1 Electrical Parts Locator, Above Transport Assembly

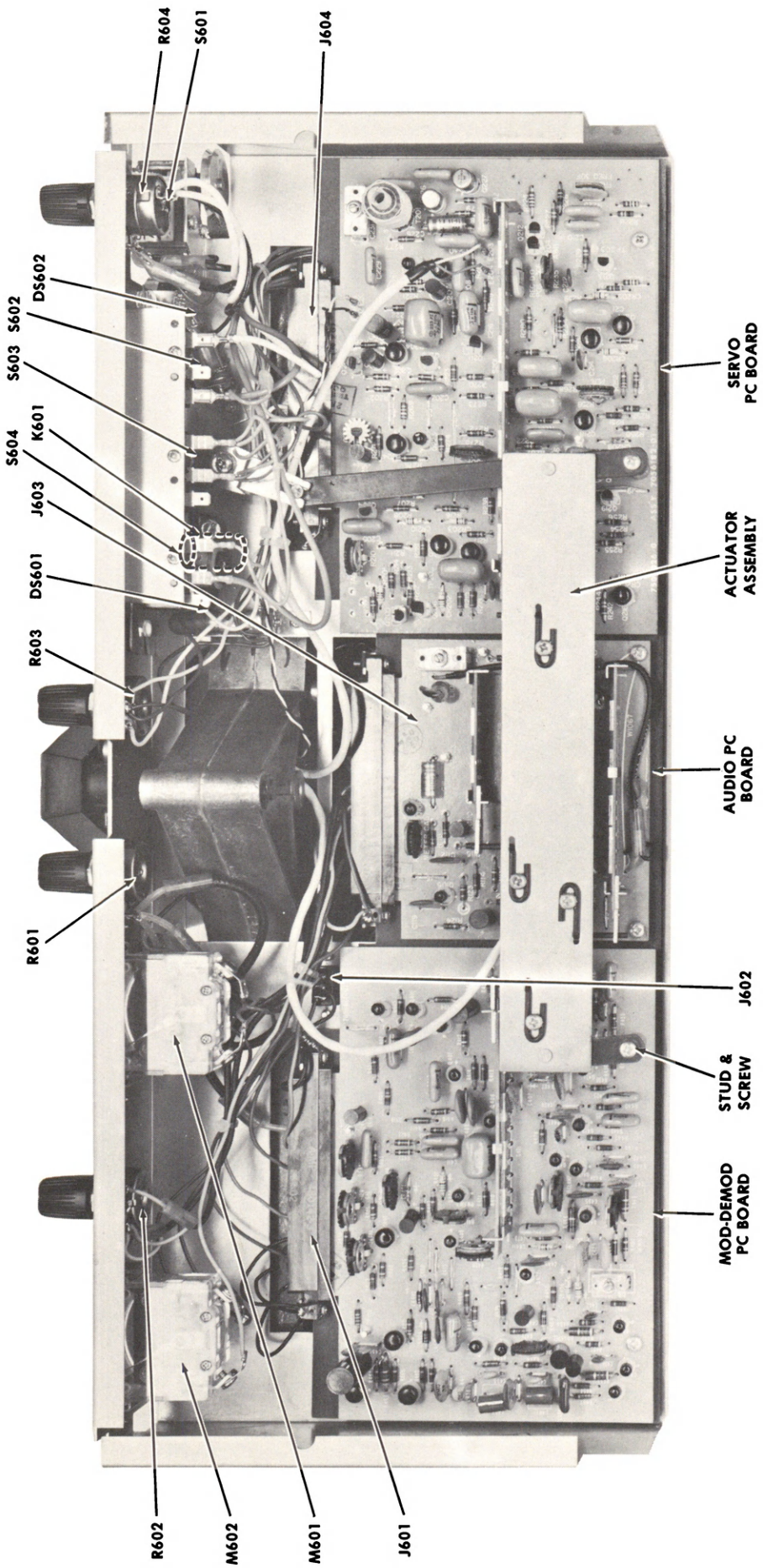
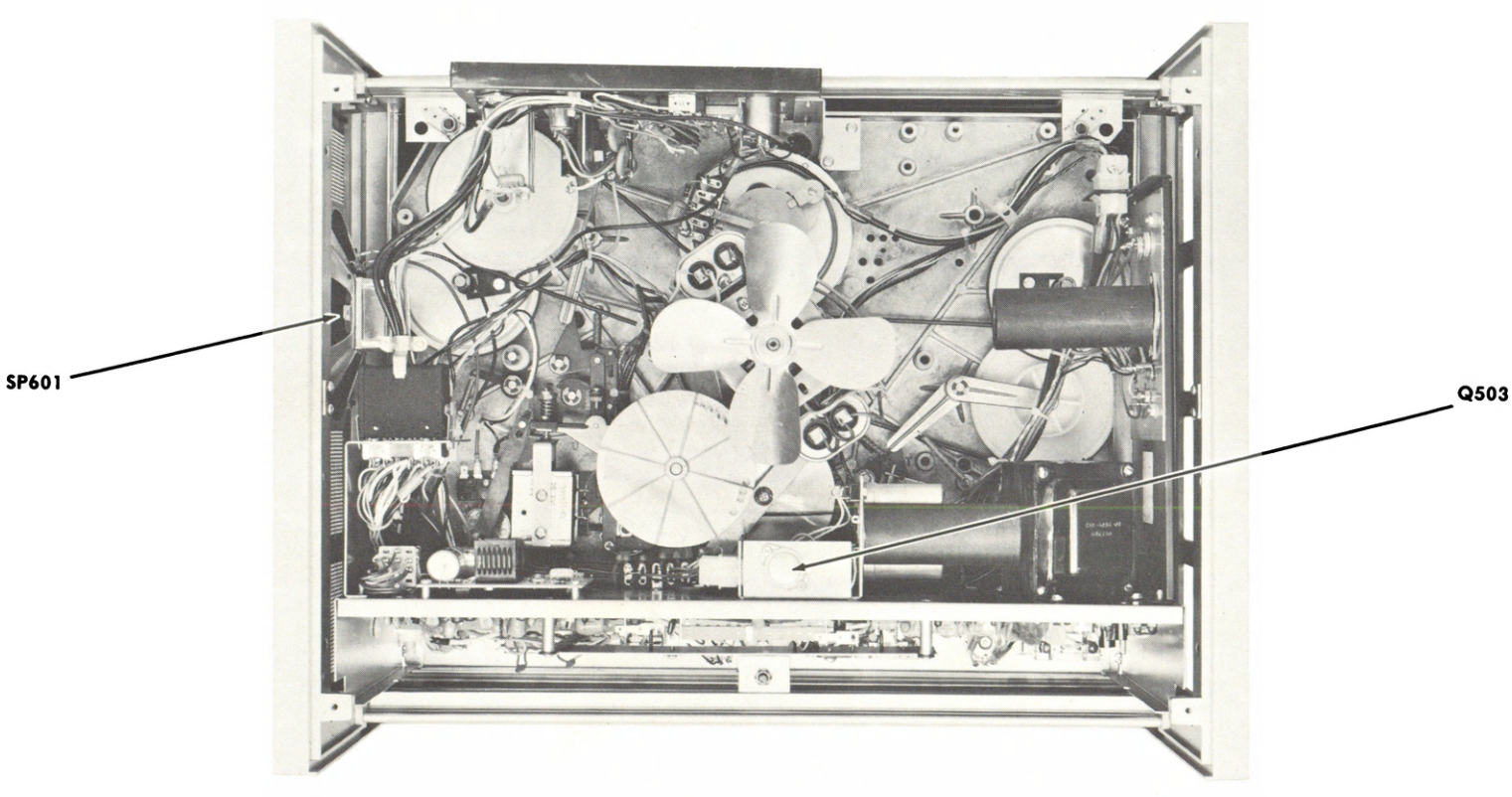


Figure 7-2. Electrical Parts Locator



*** ON LATER PRODUCTION MODELS Q503 IS MOUNTED INTERNALLY**

Figure 7-3. Electrical Parts Locator

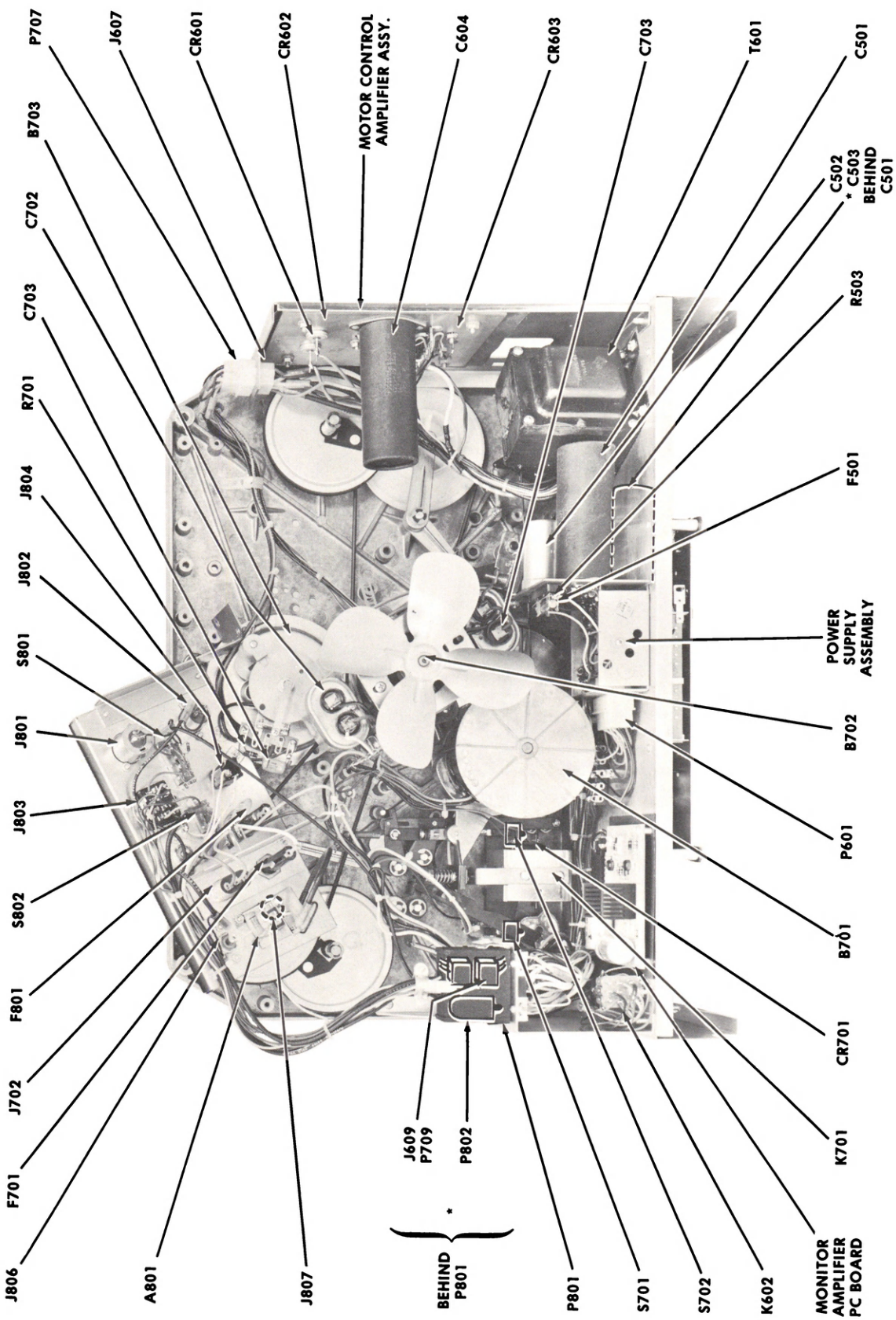
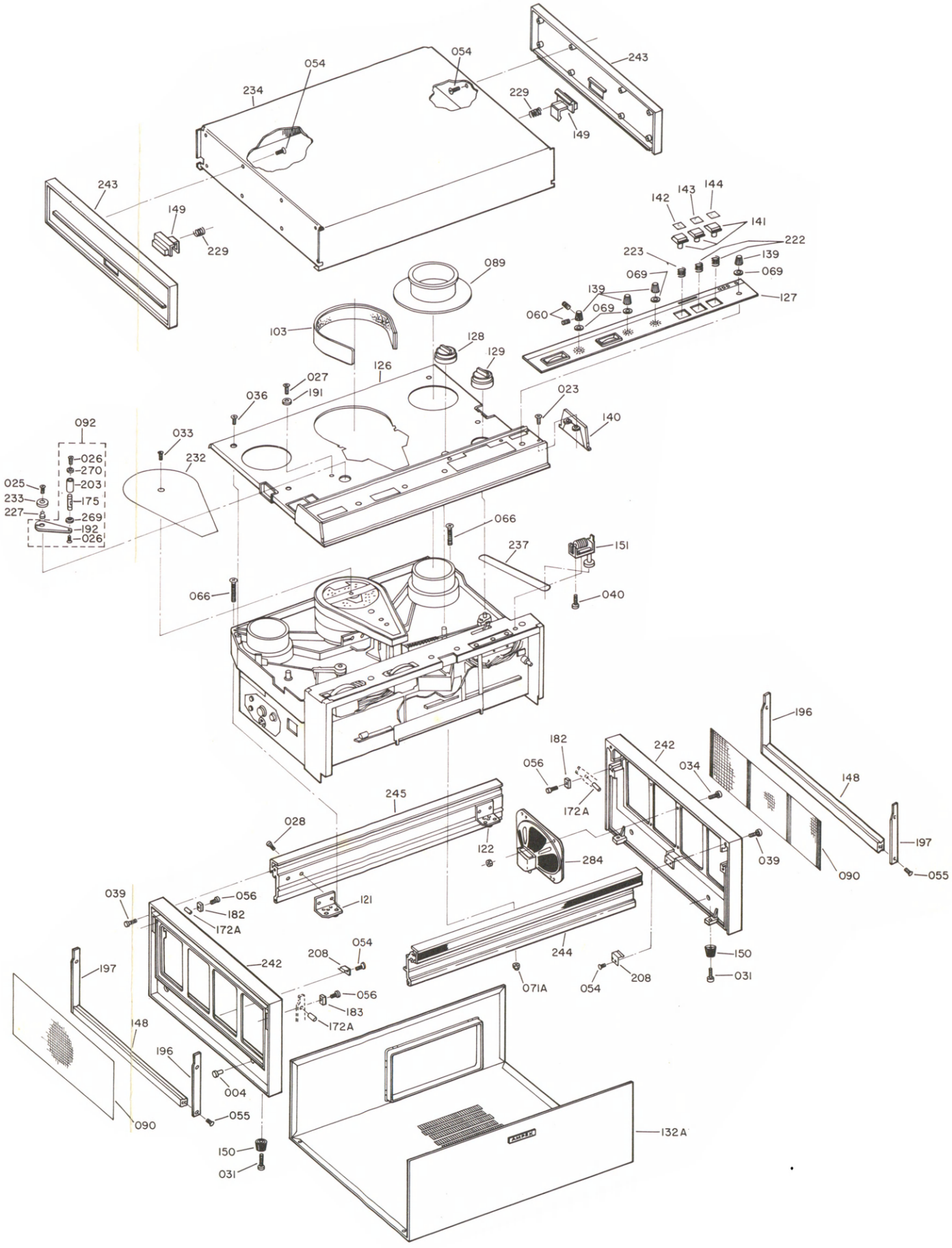
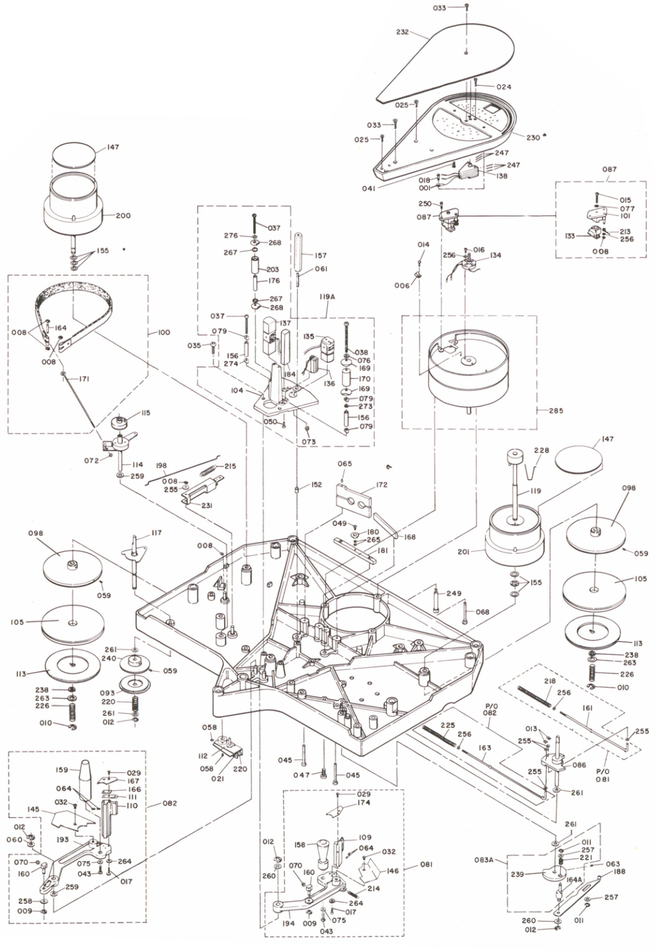


Figure 7-4. Electrical Parts Locator


054
054
234
243
229
149
243
149
229
089
103
128
129
126
027
191
036
023
140
092
033
232
026
270
203
175
269
192
026
025
233
227
066
237
151
040
066
196
182
056
172A
242
034
148
245
028
122
284
039
090
197
055
039
056
182
172A
121
208
054
242
244
150
031
071A
054
208
197
056
183
172A
148
196
004
055
090
150
031
132A

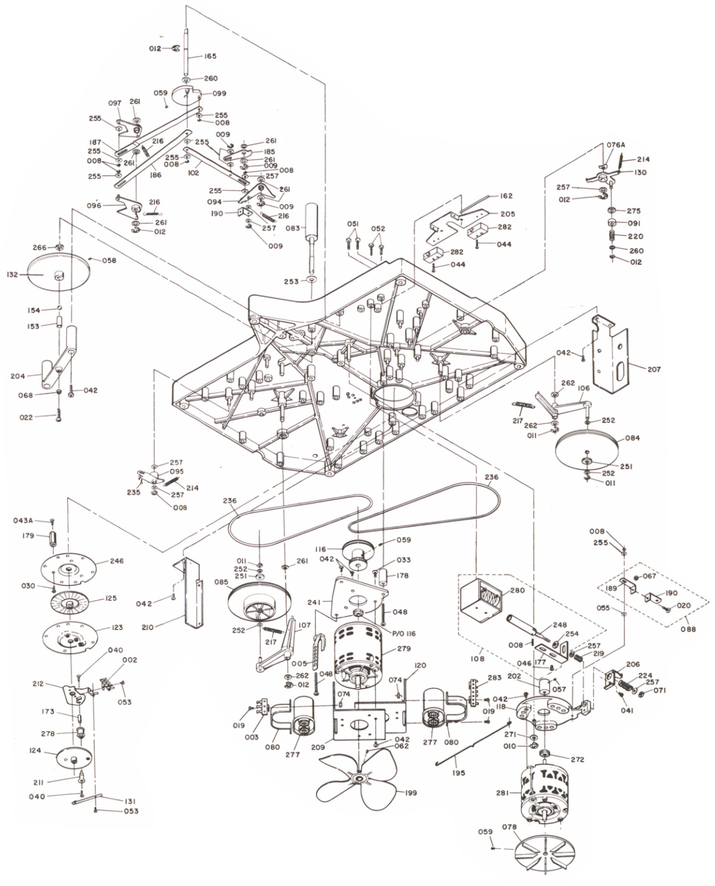
Trim Parts



EXPLODED VIEW

Parts Above Main Plate

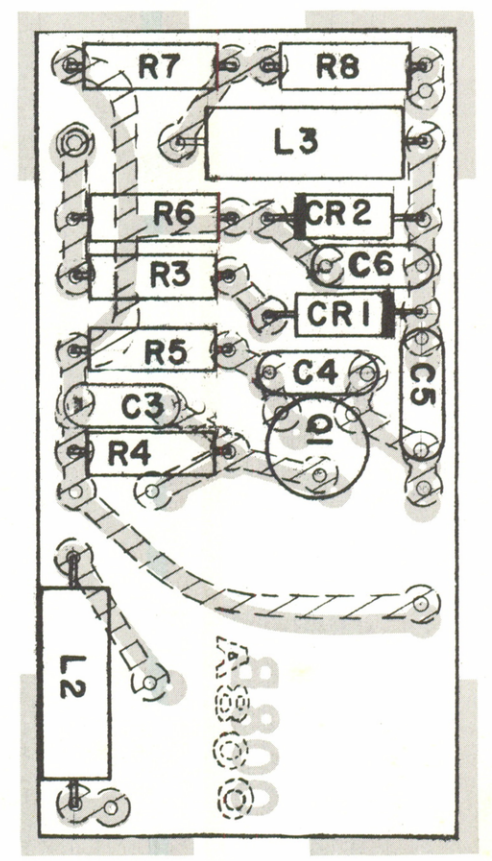
8-3A



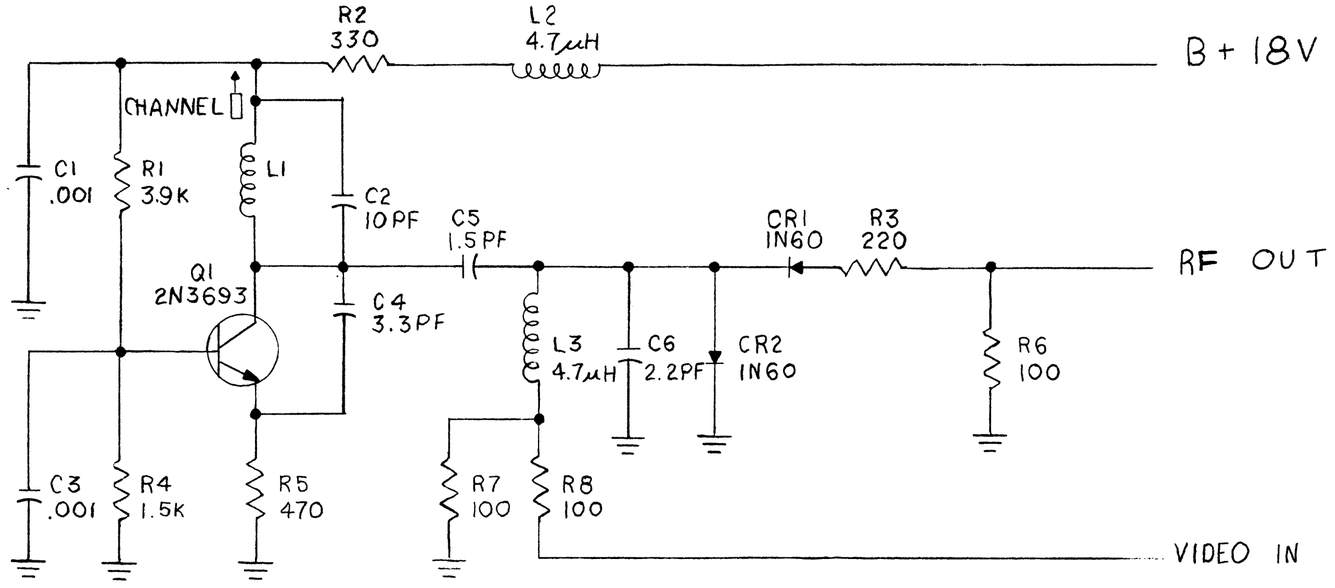
EXPLODED VIEW

Parts Below Main Plate

8-3B



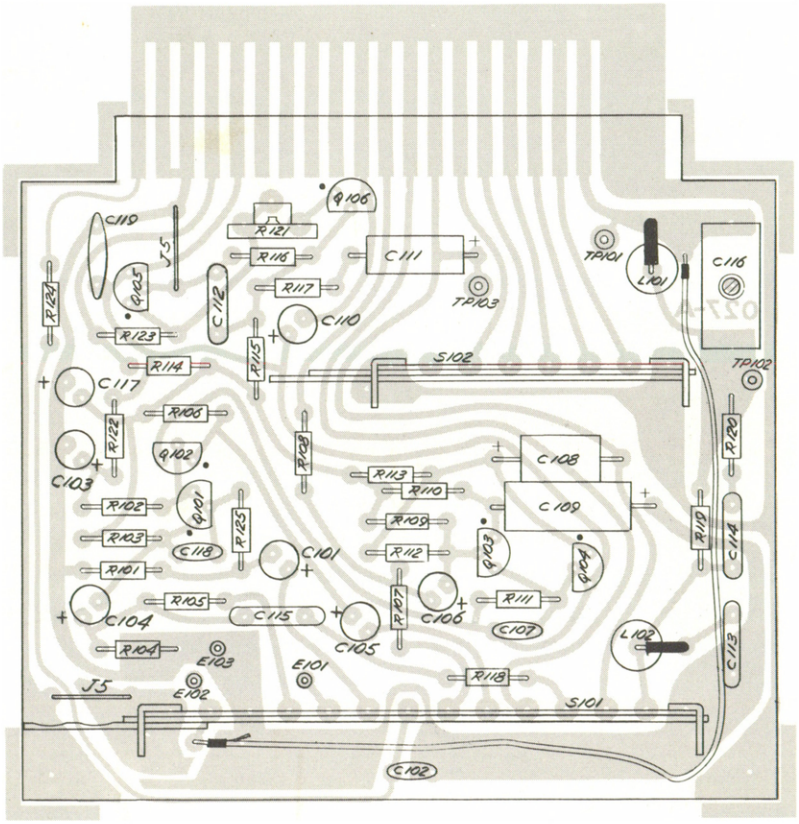
RF Modulator Circuit Board



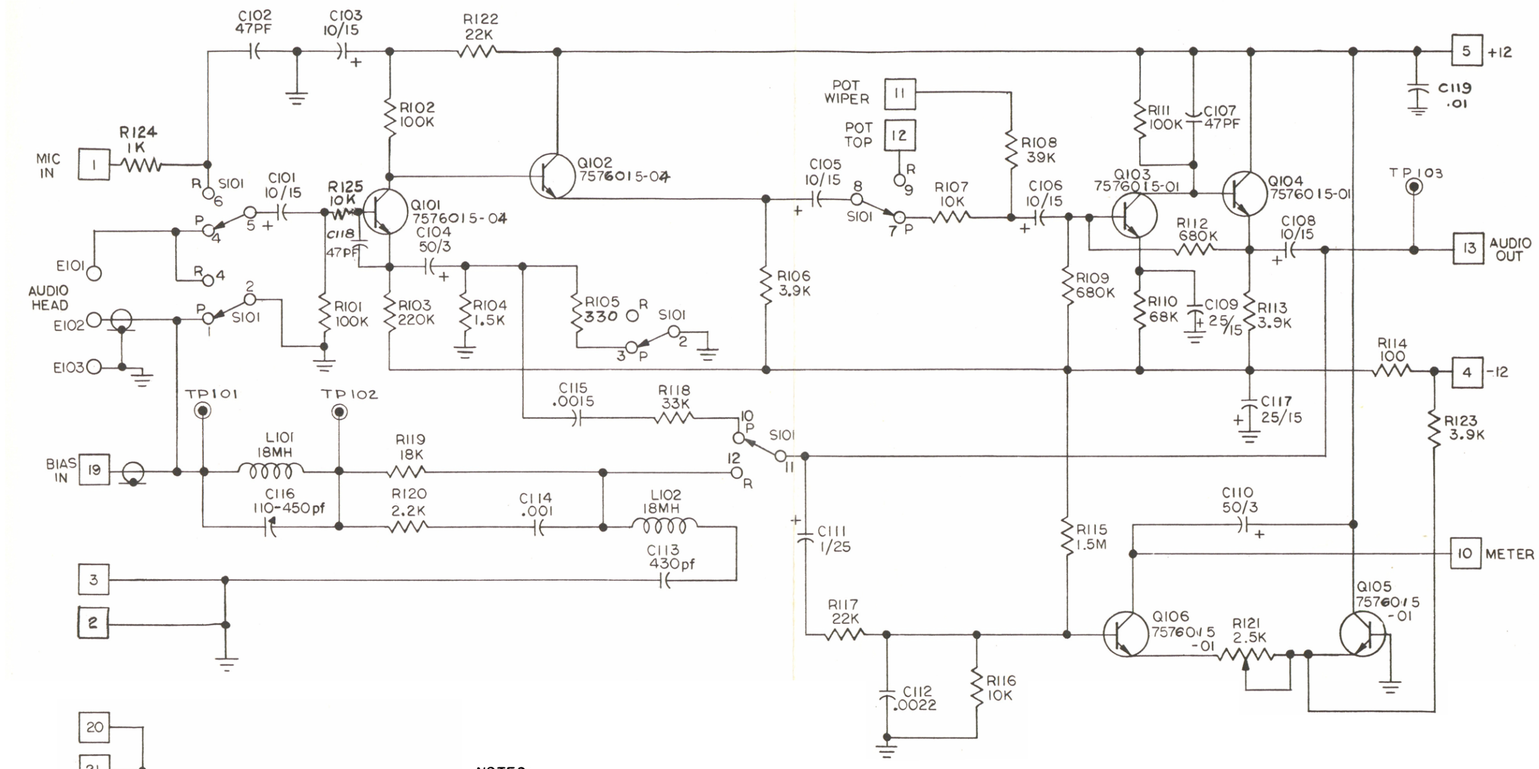
NOTES

1. ALL RESISTOR VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. ALL CAPACITOR VALUES IN MFD UNLESS OTHERWISE NOTED

RF Modulator Schematic Diagram



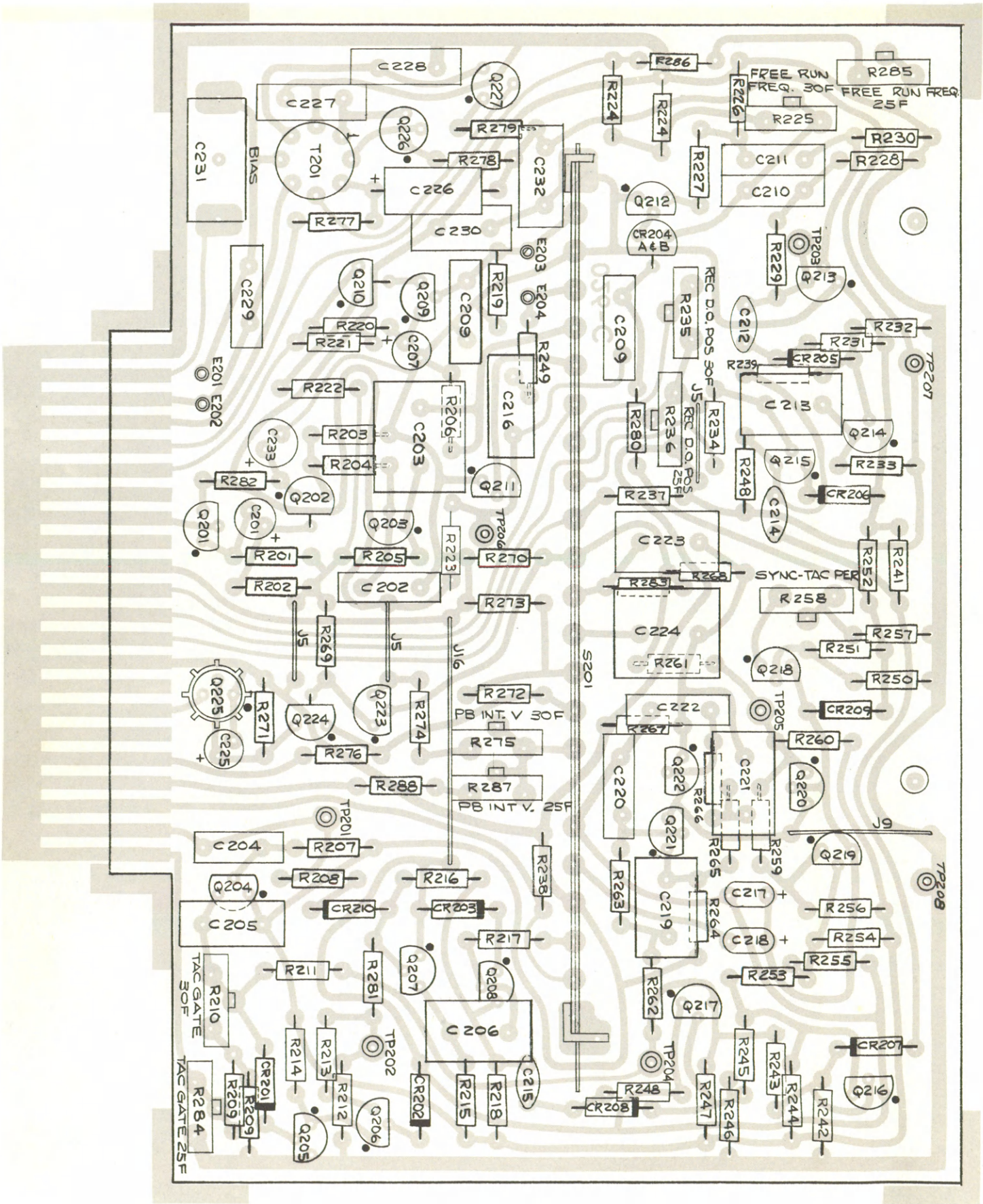
Audio Circuit Board



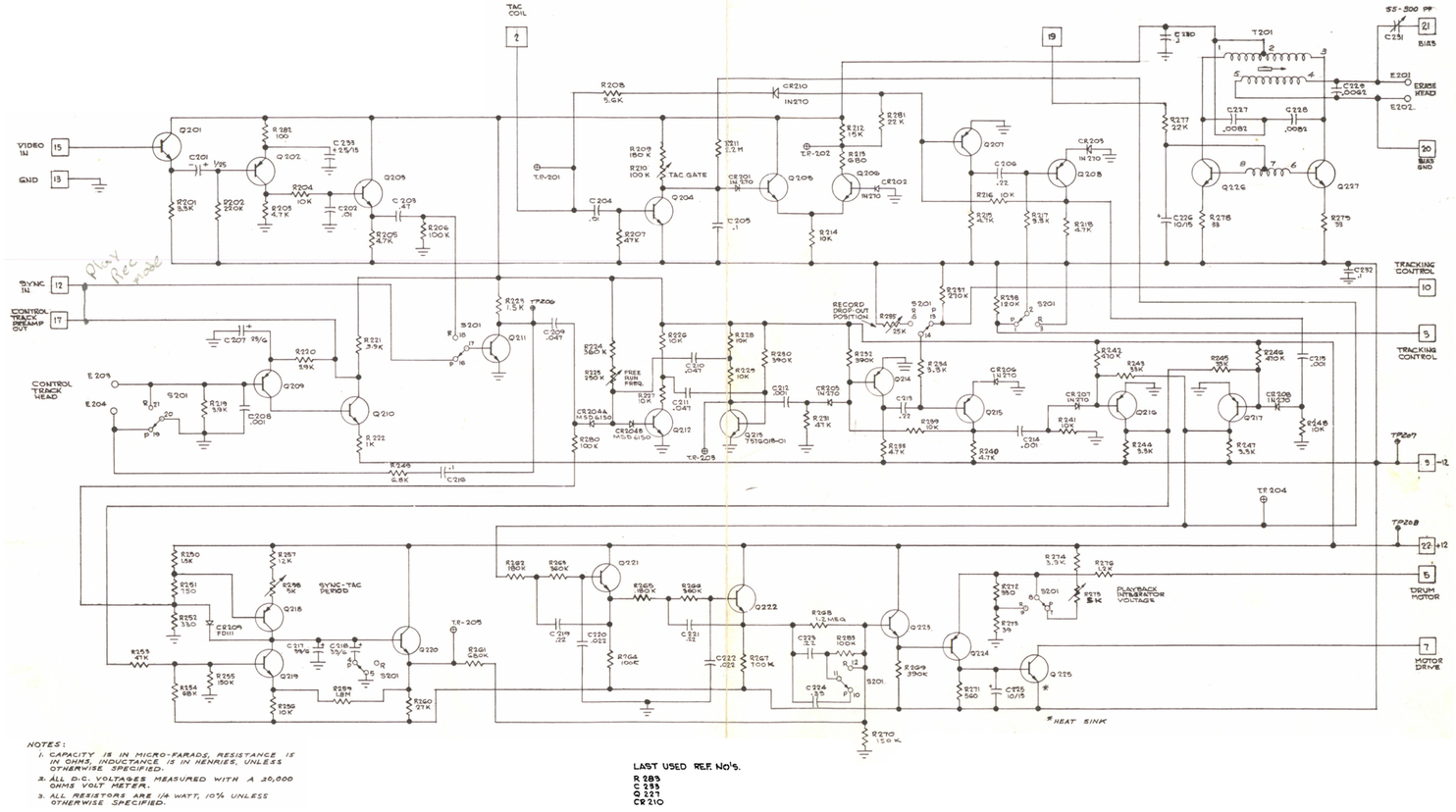
NOTES:

1. CAPACITANCE IS IN MICRO-FARADS, RESISTANCE IS IN OHMS, INDUCTANCE IS IN HENRIES, UNLESS OTHERWISE SPECIFIED.
2. ALL DC VOLTAGES MEASURED WITH A 20 000 OHMS VOLT METER.
3. ALL RESISTORS 1/4 WATT, 10%, UNLESS OTHERWISE STATED.
4. ⊙ DENOTES TEST POINT.

Audio Schematic Diagram



Servo Circuit Board



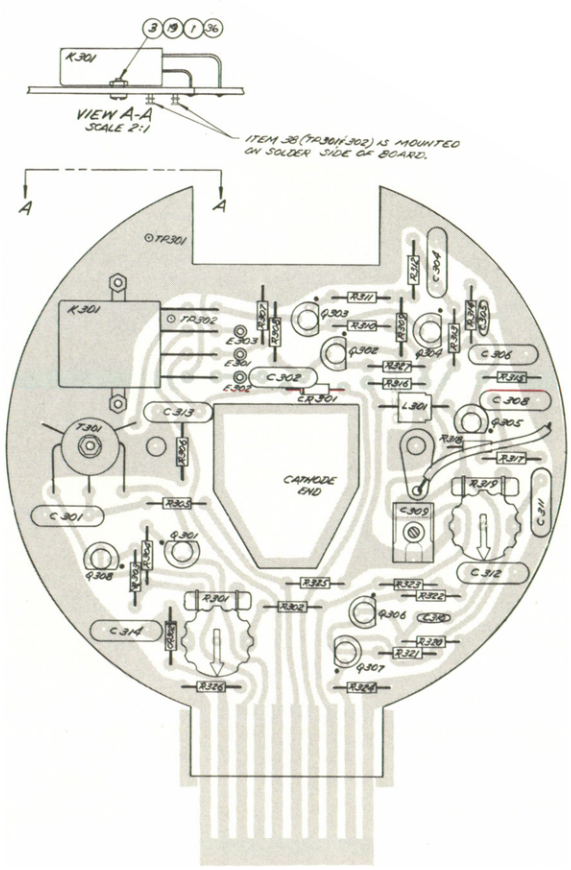
NOTES:

1. CAPACITY IS IN MICRO-FARADS, RESISTANCE IS IN OHMS, INDUCTANCE IS IN HENRIES, UNLESS OTHERWISE SPECIFIED.
2. ALL D.C. VOLTAGES MEASURED WITH A 20,000 OHMS VOLT METER.
3. ALL RESISTORS ARE 1/4 WATT, 10% UNLESS OTHERWISE SPECIFIED.

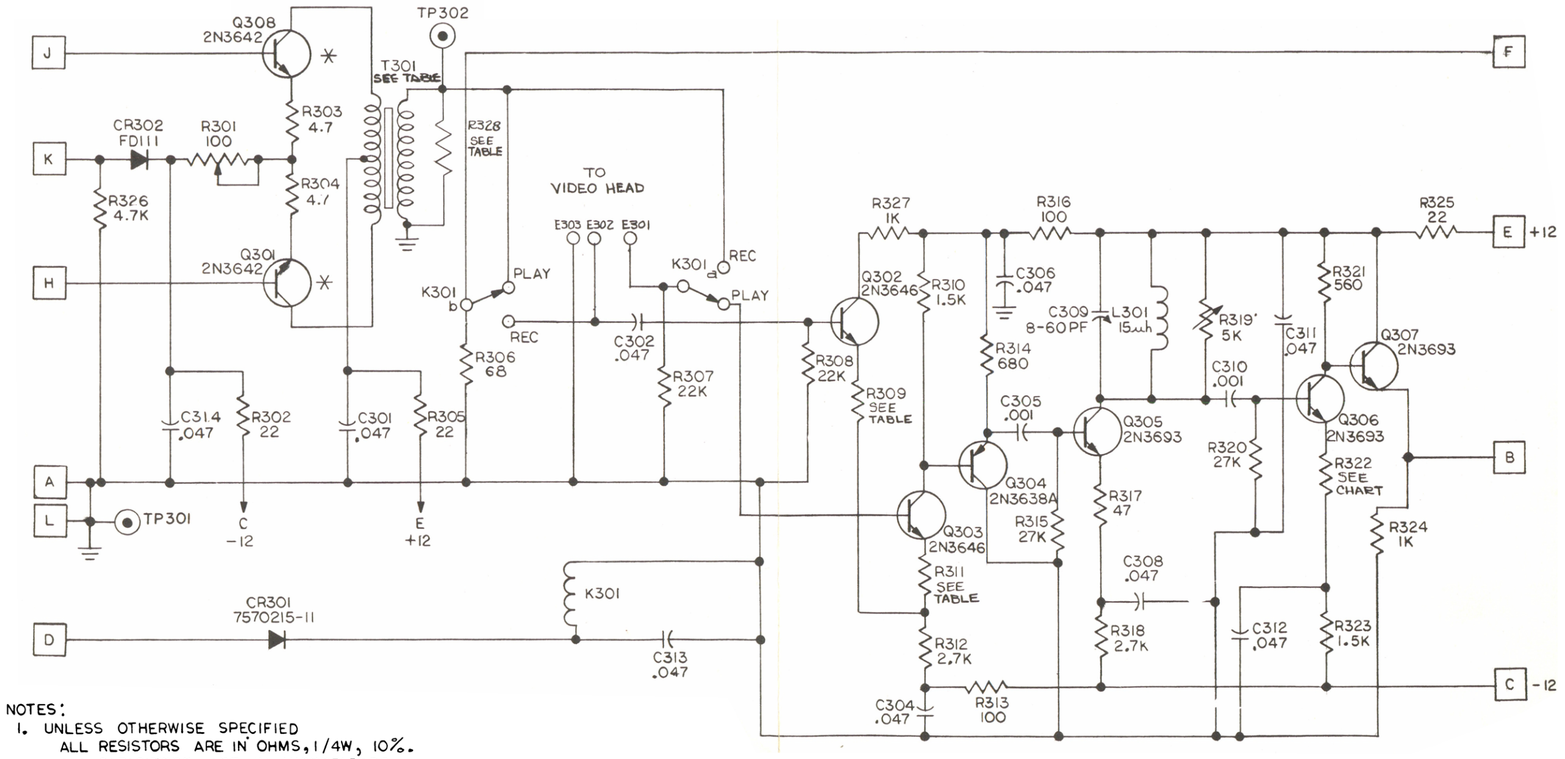
LAST USED REF. NO'S.

R 283
C 233
Q 227
CR 210

Servo Schematic Diagrams



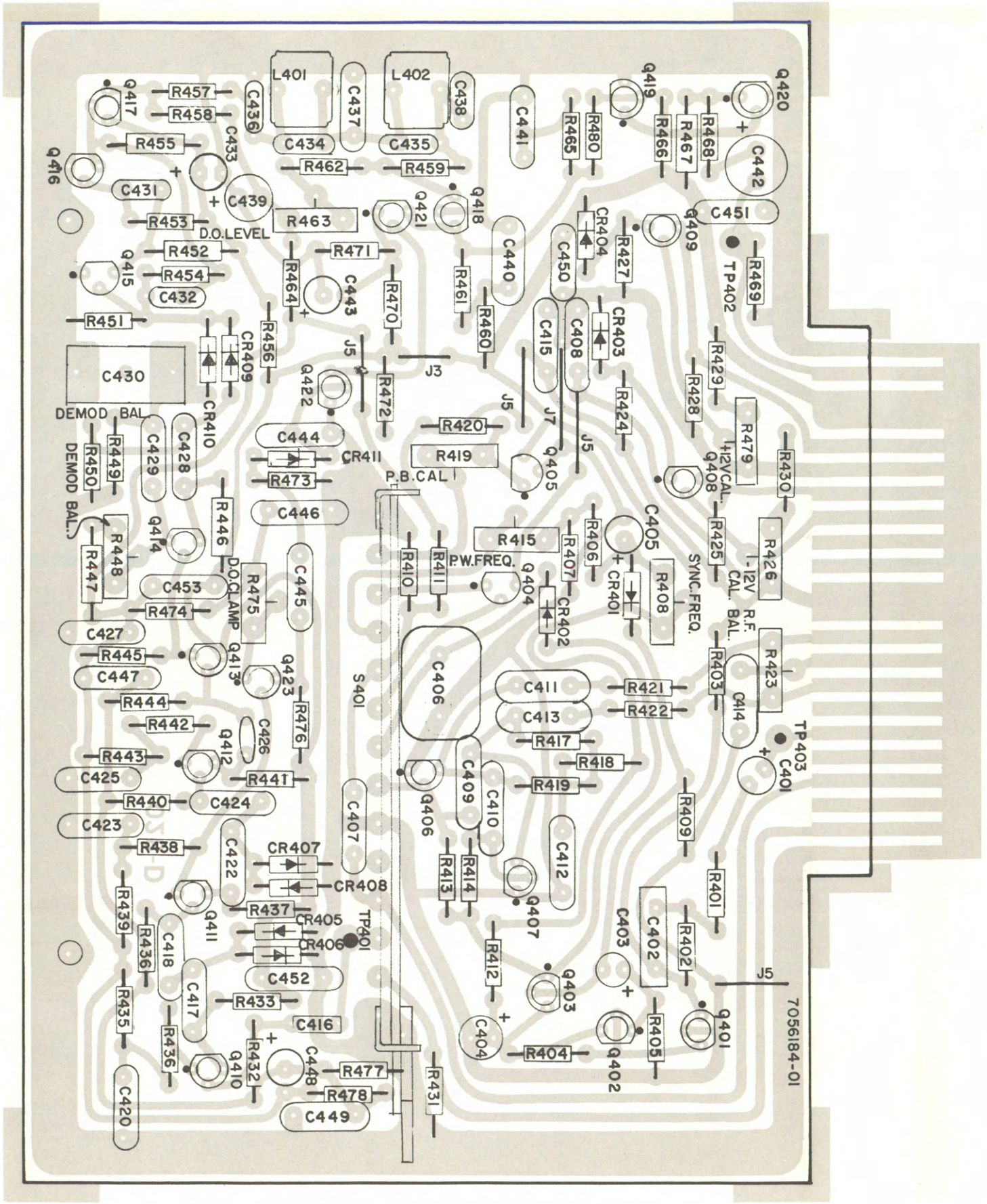
Video Preamplifier Circuit Board



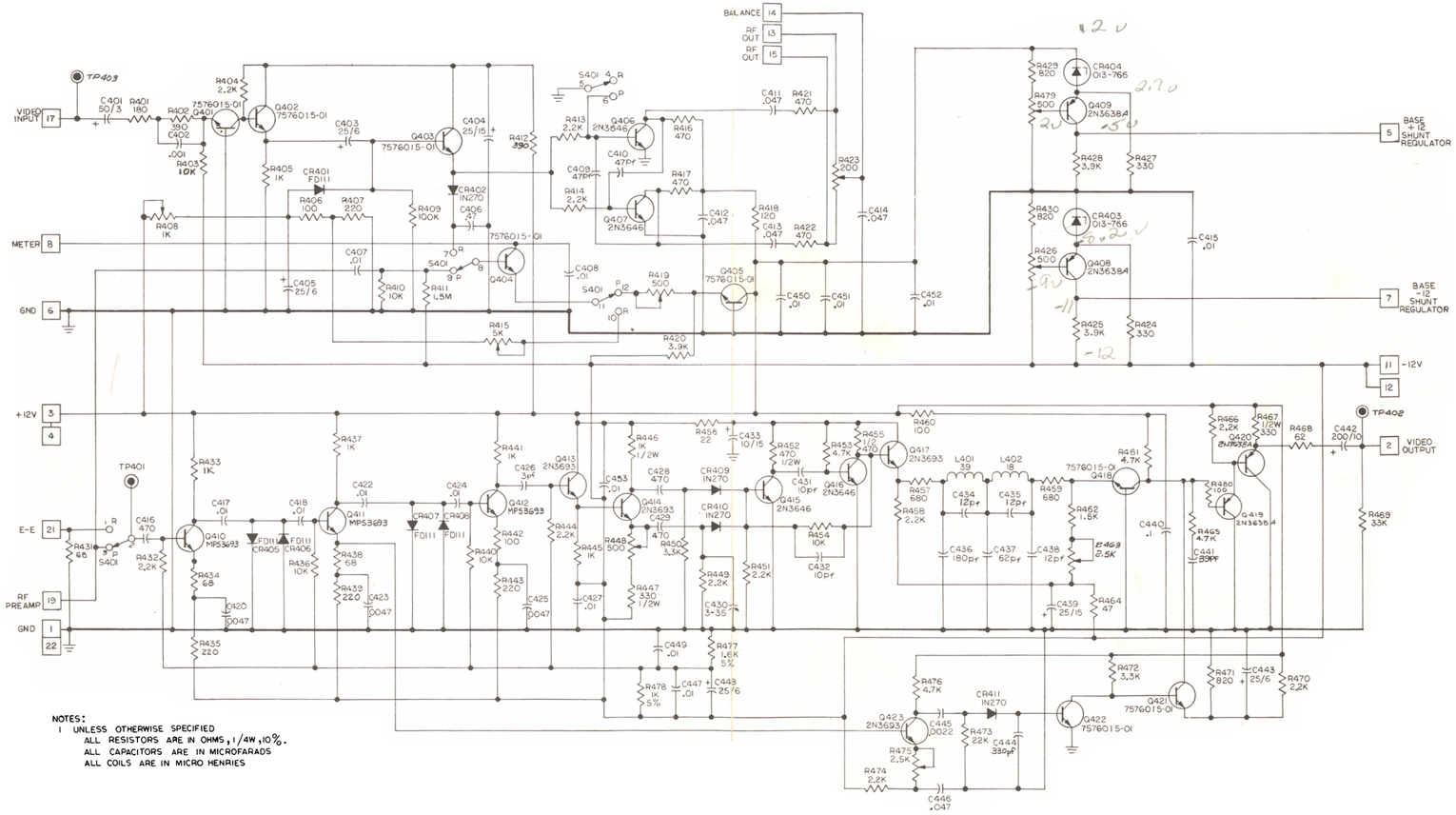
NOTES:

1. UNLESS OTHERWISE SPECIFIED
   ALL RESISTORS ARE IN OHMS, 1/4W, 10%.
   ALL CAPACITORS ARE IN MICROFARADS.
2. * DENOTES HEAT SINK.

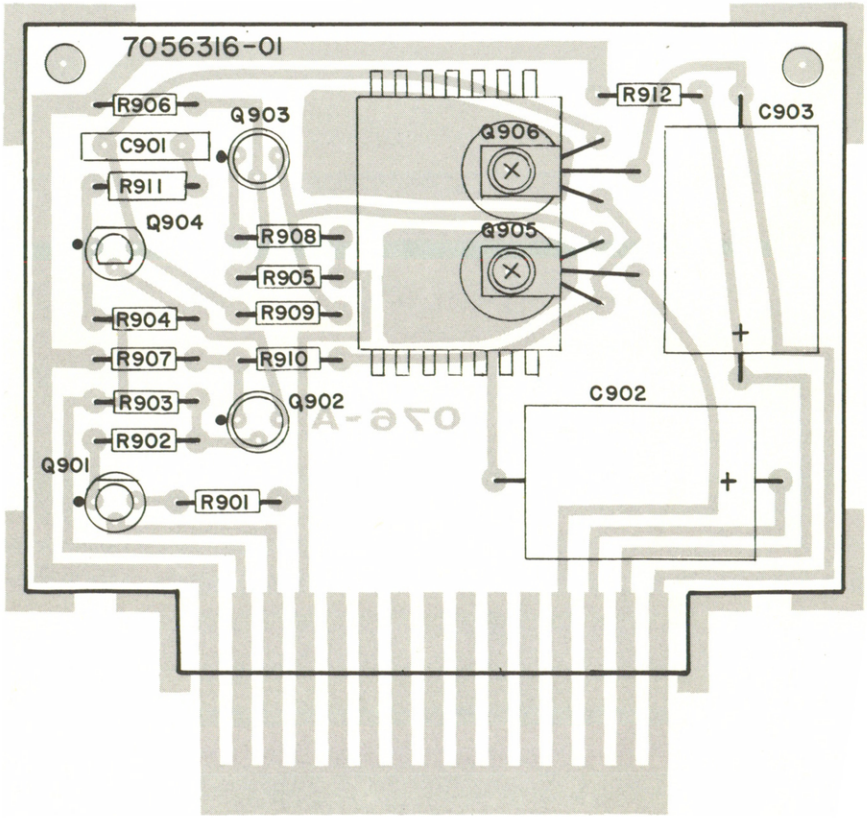
Video Preamplifier Schematic Diagram



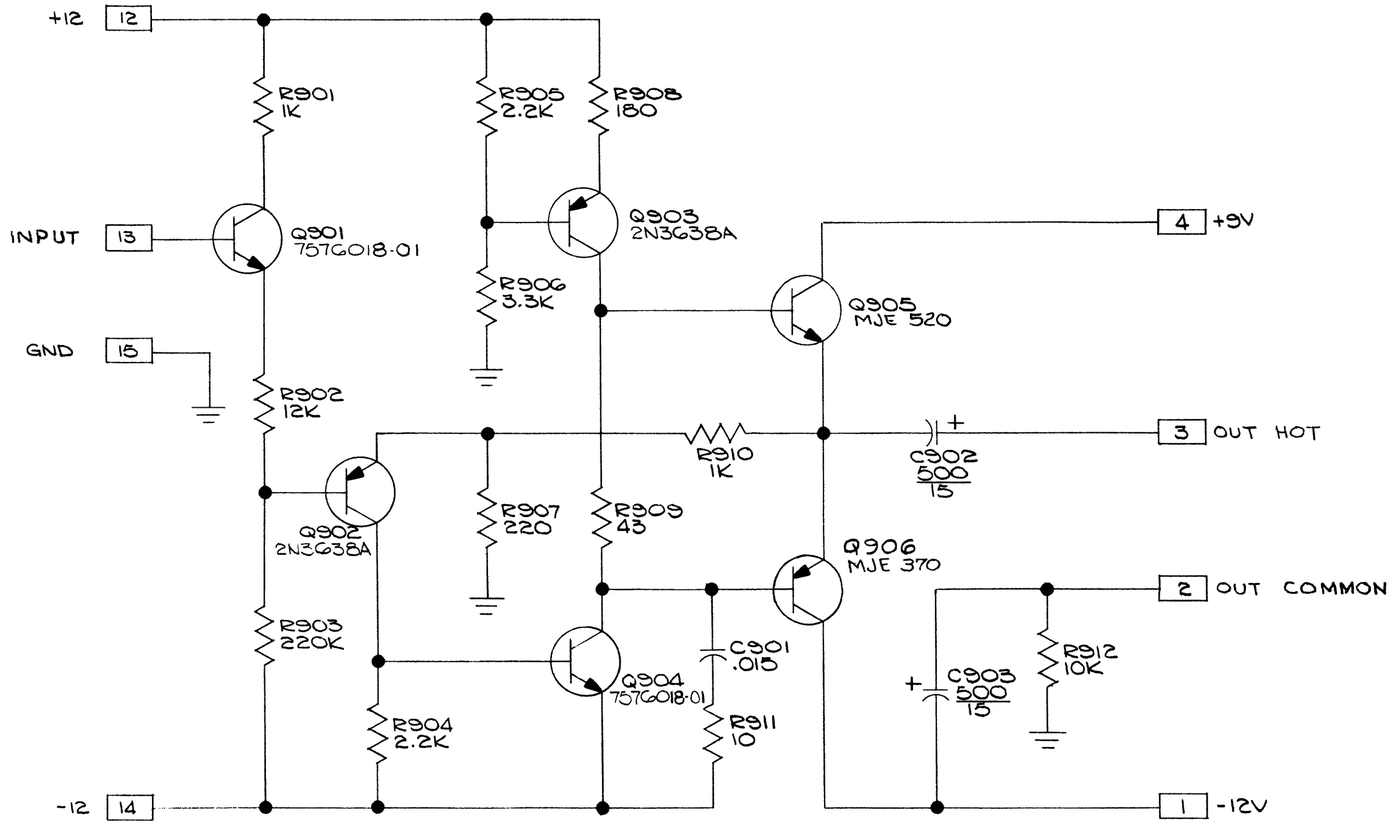
Mod-DeMod Circuit Board



Mod-DeMod Schematic Diagram



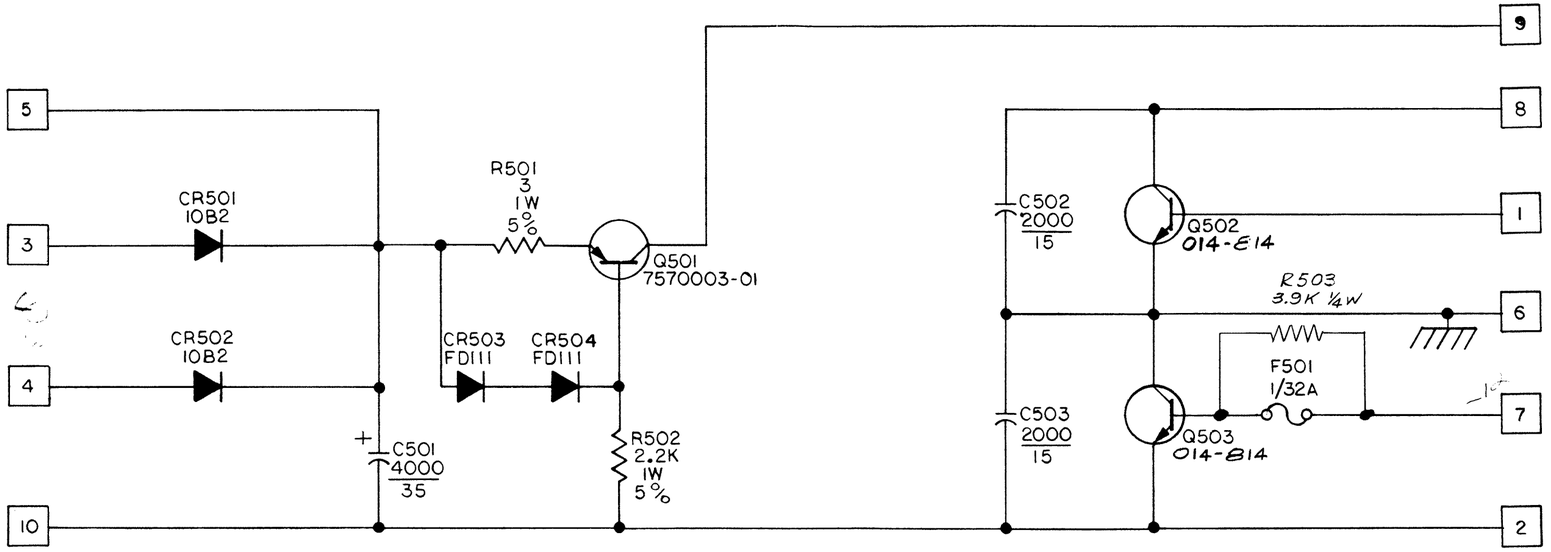
Monitor Amplifier Circuit Board



NOTES

1. CAPACITY IS IN MICRO-FARADS, RESISTANCE IS IN OHMS, INDUCTANCE IS IN HENRIES, UNLESS OTHERWISE SPECIFIED.
2. ALL D.C. VOLTAGES MEASURED WITH A 20,000 OHMS VOLT METER.
3. ALL RESISTORS ARE 1/4 WATT 10% UNLESS OTHERWISE SPECIFIED.

Monitor Amplifier Schematic Diagram



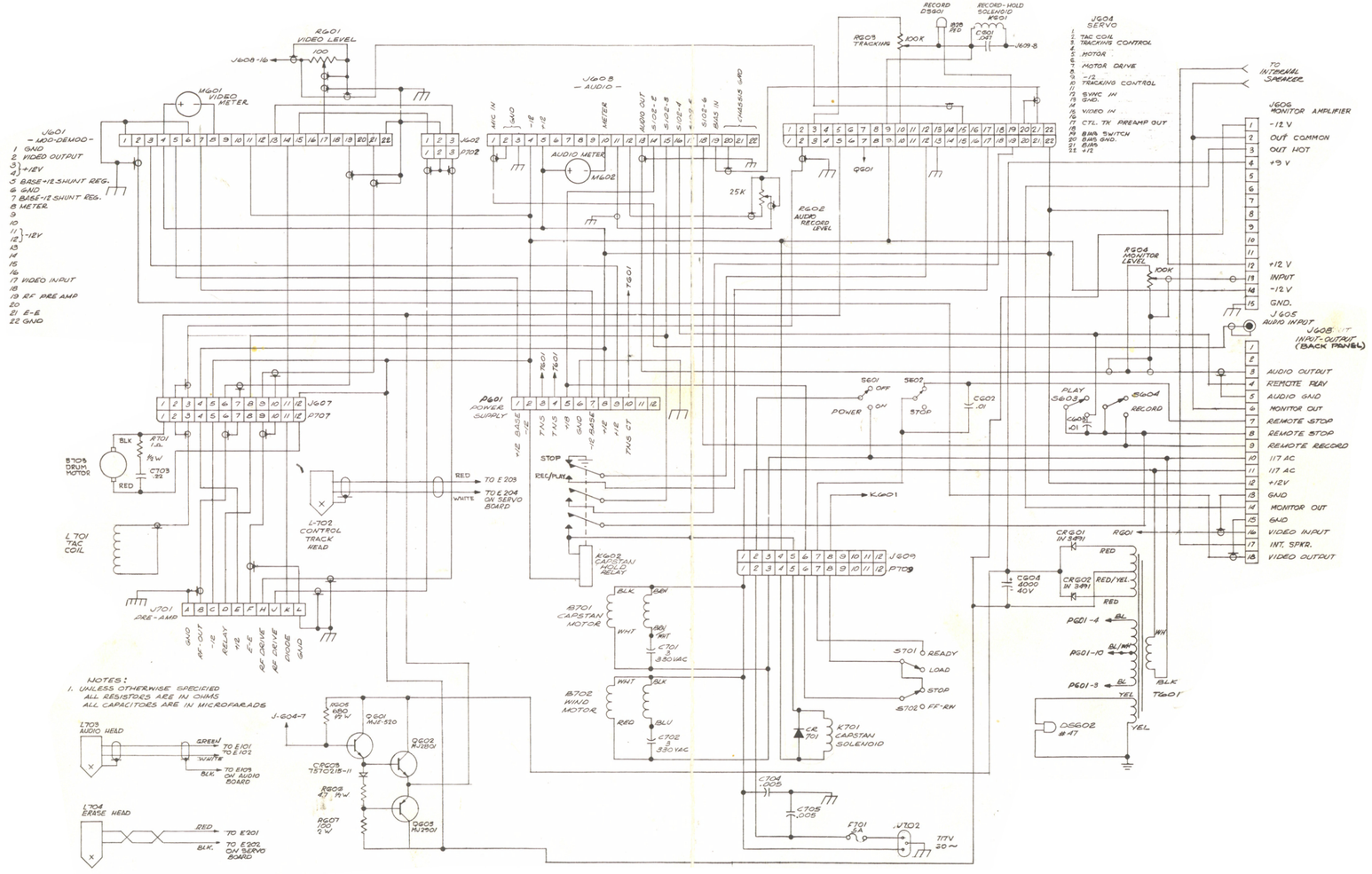
NOTES:

1. UNLESS OTHERWISE SPECIFIED

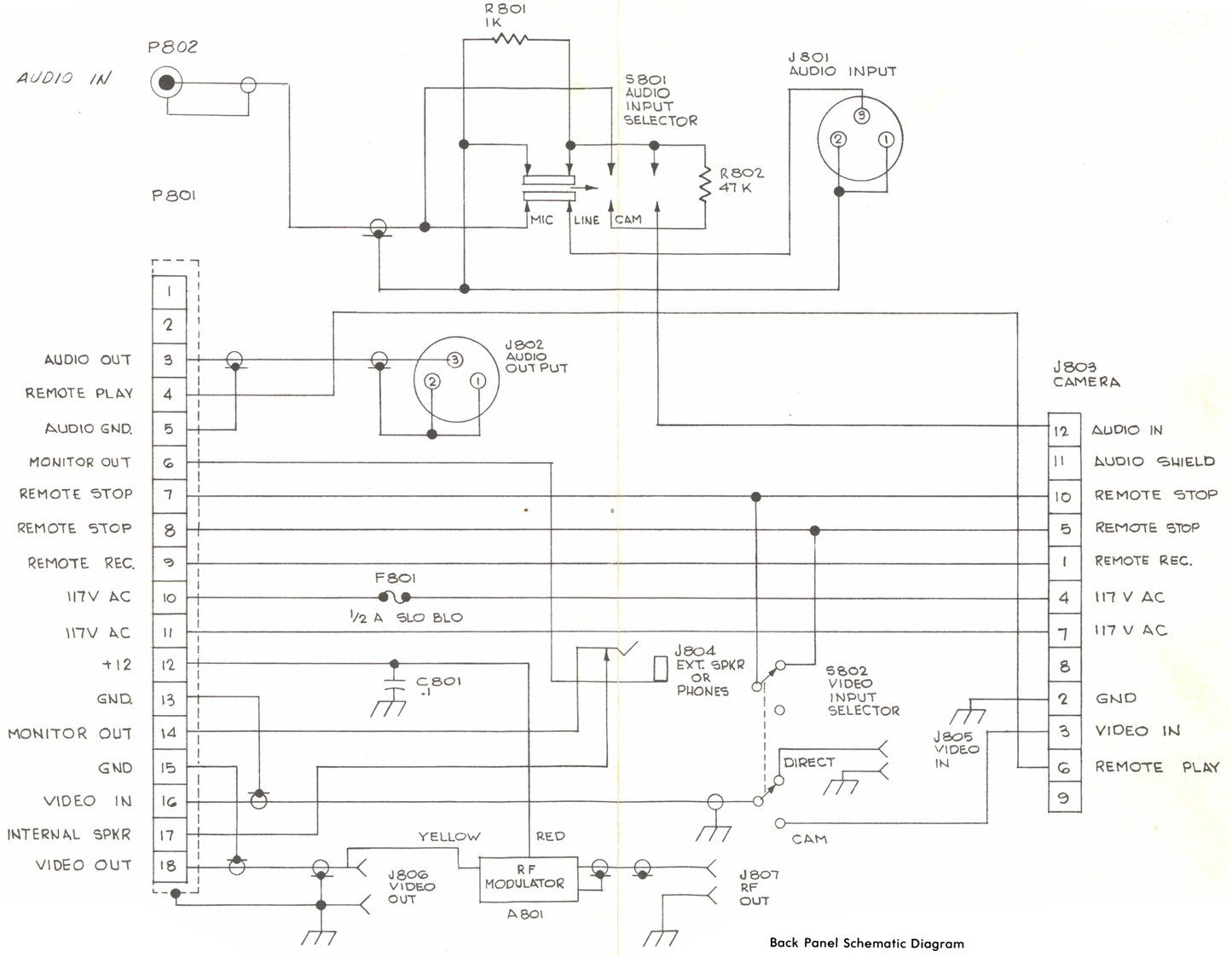
   ALL RESISTORS ARE IN OHMS.

   ALL CAPACITORS ARE IN MICROFARADS.

Power Supply Schematic Diagram



Interconnection Schematic Diagram



Back Panel Schematic Diagram